

Technical Manual No.
799816-006
Revision C

M89I CACHETAPE™ UNIT
VOLUME I
OPERATION AND MAINTENANCE

Cipher Data Products
10225 Willow Creek Road
San Diego, California 92131

NOTICE

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions included in this manual, may cause interference to radio communications. Verification of compliance with Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference, is the responsibility of the installer.

VOLUME I

TABLE OF CONTENTS

Section	Title	Page No.
I	DESCRIPTION, UNPACKING, INSPECTION,..... AND INSTALLATION	1-1
	GENERAL	1-1
	UNPACKING AND INSPECTION	1-1
	POWER CONNECTION	1-3
	INITIAL CHECKOUT	1-5
	RACK MOUNTING	1-6
	INTERFACE CONNECTIONS	1-8
	SPECIAL SOFTWARE OPTIONS	1-11
	PARITY SELECTION	1-12
	MULTIPLE-TRANSPORT OPERATION.....	1-12
	UNIT ADDRESS SELECT	1-13
	COMMANDS	1-20
II	OPERATION	2-1
	GENERAL	2-1
	CONTROLS AND INDICATORS	2-1
	LOADING TAPE	2-1
	UNLOADING TAPE	2-4
	ERROR CONDITIONS	2-4
	Operator Error Codes	2-4
	Transport Error Codes	2-4
	MANUAL LOAD	2-6
	MANUAL UNLOAD	2-6
III	TESTING AND TROUBLESHOOTING	3-1
	TESTING.....	3-1
	Power Up Self Tests	3-1
	Service Aids	3-2
	Service Aids (No Tape in Unit)	3-7
	Service Aids (Tape in Unit)	3-13
	TRANSPORT ERROR CONDITIONS	3-13

TABLE OF CONTENTS (Continued)

Section	Title	Page No.
IV	MAINTENANCE	4-1
	GENERAL	4-1
	CTU POSITIONS FOR SERVICING	4-1
	Operator Maintenance Access.....	4-1
	Service Access.....	4-3
	OPERATOR PREVENTIVE MAINTENANCE	4-3
	Tachometer Roller	4-6
	Takeup Hub	4-6
	Roller Guides	4-6
	Reel-Hub Pads	4-7
	Head	4-7
	Tape Cleaner	4-7
	Filter.....	4-7
	SERVICE TECHNICIAN PREVENTIVE MAINTENANCE ..	4-8
	CORRECTIVE MAINTENANCE	4-9
	Fuse Removal and Replacement	4-9
	Voltage Regulator Adjustment	4-9
	Read Threshold Adjustment.....	4-9
	REPAIR AND REPLACEMENT OF PARTS.....	4-10
	AND COMPONENTS	
	FRONT PANEL ASSEMBLY	4-12
	Power Switch Replacement	4-12
	Touch Switch Replacement	4-18
	Front Panel Subassembly Replacement	4-18
	Removal and Replacement of Door Assembly	4-19
	SUPPLY HUB ASSEMBLY	4-20
	Removal, Replacement and Adjustment	4-20
	HEAD ASSEMBLY.....	4-21
	Removal and Replacement of Assembly	4-21
	ROLLER GUIDE ASSEMBLY.....	4-23
	Removal and Replacement of Assembly	4-23
	EOT/BOT SENSOR ASSEMBLY.....	4-23
	Removal and Replacement	4-23

TABLE OF CONTENTS (continued)

Section	Title	Page No.
IV Con't	TACHOMETER ASSEMBLY.....	4-25
	Removal and Replacement	4-25
	COVER ASSEMBLY	4-25
	Removal and Replacement of	4-25
	Assembly and/or Parts	
	TAKEUP HUB ASSEMBLY.....	4-28
	Removal, Replacement, and Adjustment.....	4-28
	COMPLIANCE ARM AND AIR CAPACITOR	4-29
	ASSEMBLIES	
	Removal and Disassembly	4-29
	Reassembly, Installation, and Adjustment.....	4-31
	TAPE-IN-PATH SENSOR, TRANSMITTER	4-32
	Removal and Replacement	4-32
	TAPE-IN-PATH SENSOR, RECEIVER	4-33
	Removal and Replacement	4-33
	COMPLIANCE ARM BUMPER ASSEMBLY.....	4-33
	Removal and Replacement	4-33
	ROLLER TAPE GUIDE ASSEMBLY (SOLID).....	4-35
	Removal and Replacement	4-35
	FILE-PROTECT SENSOR.....	4-36
	Removal and Replacement	4-36
	DRIVE MAIN PRINTED WIRING BOARD	4-37
	Removal and Replacement	4-37
	POWER SUPPLY ASSEMBLY	4-38
	Removal and Replacement	4-38
	POWER SUPPLY PWB	4-41
	Removal and Replacement	4-41
	TAKEUP MOTOR ASSEMBLY.....	4-41
	Removal, Replacement and Adjustment	4-41
	AIR DUCT TOP PLATE	4-43
	Removal and Replacement	4-43
	Front Panel Air Duct	4-43
	Air Intake Tube	4-45

TABLE OF CONTENTS (continued)

Section	Title	Page No.
IV con't	SUPPLY MOTOR ASSEMBLY	4-45
	Removal and Replacement	4-45
	HUB LOCK ASSEMBLY	4-47
	Disassembly, Removal and Replacement.....	4-47
	Reassembly and Installation	4-47
	MANUAL UNLOCK ASSEMBLY	4-47
	Removal and Replacement	4-47
	DOOR LOCK ASSEMBLY	4-48
	Removal and Disassembly	4-48
	TRANSFORMER ASSEMBLY	4-49
	Removal and Replacement	4-49
	TAPE ALIGNMENT.....	4-50
	Head Azimuth Adjustment.....	4-53
V	ILLUSTRATED PARTS BREAKDOWN.....	5-1
	INTRODUCTION.....	5-1
	EXPLANATION OF PARTS LIST	5-2

VOLUME I

LIST OF ILLUSTRATIONS

Figure No.	Title	Page No.
1-1	CacheTape™ Unit	1-2
1-2	Rack Mounting.....	1-7
1-3	Partial PWB Layout	1-14
1-4	Daisy Chain Cable Configuration	1-15
1-5	Daisy Chain Configuration.....	1-16
1-6	Hybrid Daisy Chain With CacheTape	1-16
	and Embedded Formatter Drives	
2-1	Control Panel.....	2-4
2-2	Tape Threading Path.....	2-7
3-1	Front Panel Controls and Indicators.....	3-1
	(Diagnostic Mode)	
3-2	Power Up Self Test Process.....	3-3
3-3	Service Aid 21 Sequence Timing.....	3-8
3-4	Service Aid 42 Sequence Timing.....	3-12
4-1	Operator Maintenance Access.....	4-2
4-2	Service Access.....	4-4
4-3	Tape Path and Related Parts.....	4-5
4-4	Air Filter Removal	4-8
4-5	Model CTU Tape Transport (Top View)	4-14
4-6	Model CTU Tape Transport (Bottom View)	4-16
4-7	Front Panel Assembly.....	4-17
4-8	Supply Hub Assembly	4-20
4-9	Supply Hub Adjustment	4-21
4-10	Head Assembly	4-22
4-11	Roller Guide Assembly.....	4-23
4-12	EOT/BOT Assembly	4-24
4-13	Tachometer Assembly	4-26
4-14	Top Cover Assembly.....	4-27
4-15	Takeup Hub	4-28

LIST OF ILLUSTRATIONS (Continued)

Figure No.	Title	Page No.
4-16	Takeup Hub Adjustment	4-29
4-17	Compliance Arm and Air Capacitor Assemblies.....	4-30
4-18	Tape-In-Path Sensor, Transmitter	4-33
4-19	Tape-In-Path Sensor, Receiver	4-34
4-20	Compliance Arm Bumper Assembly	4-34
4-21	(Solid) Tape Guide Assembly	4-35
4-22	File Protect Sensor	4-36
4-23	Drive Main Printed Wiring Board	4-37
4-24	Power Supply Assembly	4-39
4-25	Power Supply PWB	4-40
4-26	Takeup Motor Assembly	4-42
4-27	Top Plate Air Duct, Front Panel Air Duct and Air Intake Tube	4-44
4-28	Supply Motor Assembly	4-46
4-29	Hub Lock Assembly.....	4-46
4-30	Door Lock Assembly	4-48
4-31	Transformer Assembly	4-50
4-32	Tape Path Adjustment	4-52
4-33	Skew Adjustment Waveform	4-54
4-34	Reference Edge Measurement Waveform	4-55
	(TPI0) Using Pericomp Tracking Tape	
5-1	CacheTape Unit (Assembled View).....	5-5
5-2	CacheTape Unit (Exploded View)	5-11
5-3	Front Panel Assembly (Exploded View)	5-16
5-4	Top Cover Assembly (Exploded View)	5-18
5-5	Top Plate/Chassis Assembly (Exploded View).....	5-21
5-6	Drive Formatter PWB Assembly (Exploded View)	5-43
5-7	Harness Assembly	5-47
5-8	Power Supply Housing Assembly	5-51
5-9	Supply Hub Assembly	5-55
5-10	Power Supply PWB Assembly.....	5-57
5-11	Drive Formatter PWB (Orthographic View).....	5-59

VOLUME I

LIST OF TABLES

Table No.	Title	Page No.
1-1	Operating Voltage Selection	1-4
1-2	Unit Address Select	1-13
1-3	Interface Signals, Controller to Transport	1-17
1-4	Interface Signals, Transport to Controller	1-18
1-5	Configuration Switch (U3T) Settings	1-19
1-6	Command Decoding	1-23
1-7	Read Extended Status.....	1-24
2-1	Controls and Indicators	2-2
2-2	Operator Error Front Panel Indications.....	2-5
3-1	Tests 1 through 6 PUST Failure Codes.....	3-4
3-2	Test 7 PUST Failure Codes	3-5
3-3	Tests 8-13 PUST Failure Codes.....	3-6
3-4	Service Aids 22/23 Display Conversion (BOT/EOT)	3-9
3-5	Service Aid 24 Display Conversion (Compliance Arm)	3-10
3-6	Transport Error Codes	3-14
3-7	I/O Definitions (CIO)	3-17
4-1	Preventive Maintenance Schedule	4-6
4-2	Repair and Maintenance Tool/Parts List.....	4-11
4-3	Reference Edge Distance.....	4-55

SECTION I

DESCRIPTION, UNPACKING, INSPECTION AND INSTALLATION

GENERAL

I-1. The Model M89I CacheTape™ Unit (CTU) is a one-half inch, nine-track magnetic tape transport manufactured by Cipher Data Products, Inc., San Diego, California. The CTU simulates the performance characteristics of traditional start/stop tape drives while using the reliable Microstreamer® tape drive mechanical components. It incorporates the industry standard interface, a dual-gap head and all control, formatting and read/write electronics on a single printed-wiring board (PWB). The CTU will operate on 100, 120, 208, 220, 230 or 240 VAC, single-phase, 50-60 Hz line power. Reels to 10.5 inches can be accommodated. Tape speed and density capabilities are:

- a. Model M89I-I CTU (1600 characters per inch CPI)
 - (1) 100 ips at 1600 CPI Phase-Encode (PE)
- b. Model M89I-II CTU (3200 CPI)
 - (1) 100 ips at 1600 CPI (PE)
 - (2) 50 ips at 3200 CPI

The simulated tape speed capability is switch selected and includes 45, 75, 100, 120, 140, 170, 200, and 300 (approximate) ips. Refer to Table I-5 for the switch settings.

UNPACKING AND INSPECTION

I-2. The CTU is shipped in a single carton reinforced to minimize the possibility of damage during shipment. Unpack as follows:

- a. With shipping container on floor or workbench, cut side and center tapes securing top of box.
- b. Pull top flaps down along sides of box. Remove the upper foam blocks and place the CTU on a workbench or table. Remove the manual and installation hardware from shipping carton.
- c. Check contents of shipping container against the packing slip and inspect for possible damage. **If damage exists, notify carrier.**

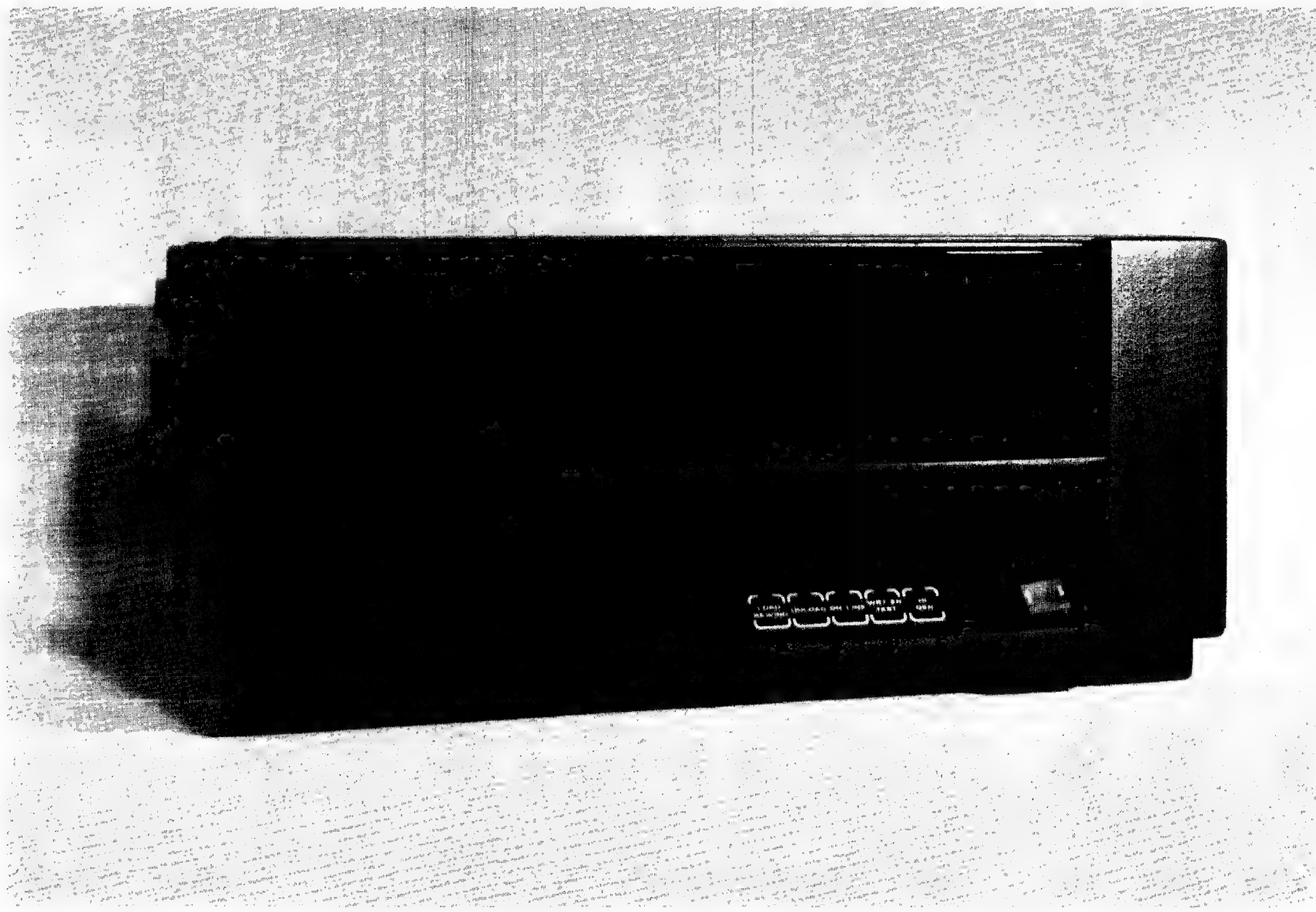


Figure I-1. CacheTape™ Unit

- d. Refer to the illustration taped to the front door. Remove tape holding top cover and front door in place. Open top cover by lifting sides directly behind front panel. Place cover stay (left-rear of top cover) in the slot provided. This is the maintenance access position. Pull tachometer (spring-loaded arm at left-rear of unit) away from hub and discard the foam cushion. Carefully replace tachometer assembly against hub.
- e. Examine the hubs, tachometer, and other components in tape path area for foreign matter.
- f. Using a screwdriver, loosen two captive screws at front sides of top plate casting. Close the top cover. Lift front panel (and top plate casting) by grasping the two lower corners. Lift unit to its maximum upright position. Latch mechanism will automatically engage when unit is lowered approximately one inch. Insert the safety pin provided through both holes in the top plate support from outside inward (Figure 4-2). This is the service access position.
- g. Remove 3 pieces of foam packing material from PWB. Check PWB and all connectors for correct installation.
- h. To release latch mechanism, remove the safety pin and lift front panel before lowering it. Open top cover and tighten captive screws. Close top cover.
- i. Do not replace packing tape or foam cushion materials.
- j. Verify that the operating voltage indicated on the manufacturers label (rear of chassis) matches the power outlet voltage for the unit. If not, refer to paragraph 1-4 for instructions to change the operating voltage.

POWER CONNECTION

CAUTION

To prevent damage to the CTU and ensure proper operation, be sure the outlet voltage is correct before applying power to the CTU.

1-3. A power cord is supplied only for the voltage range indicated on the manufacturer's label.

1-4. **Operating Voltage Selection.** The CTU can be operated over a wide range of line voltages by selection of the appropriate power supply voltage option. To change the power supply option, proceed as follows:

CAUTION

When CTU is to be extended on slides from equipment rack, ensure that rack is mounted securely. Weight of CTU in extended position could upset an inadequately mounted equipment rack.

- a. Switch transport power OFF and remove power cord from outlet.
- b. Open unit to service access position. Refer to paragraph 1-2 (f).
- c. Place a shop cloth or similar item over the PWB in the area of the power supply assembly.

WARNING

Dangerous voltages can be encountered in the next two steps if the power cord is connected to an AC source or if the unit has had power applied in the last two minutes.

- d. Refer to Figure 4-23. Remove two phillips head screws securing power supply cover, noting position of chassis ground cable. Pivot cover to the right and slide forward to remove.
- e. Remove voltage selection card (4, Figure 4-25) from J9 on power supply PWB. Noting position of key slot on voltage selection card, reinstall the card in J9 to correspond to the desired voltage. Refer to Table 1-1.
- f. Reverse steps c and d.
- g. Replace the fuse, if required, with one of the correct current rating for the voltage selected. Refer to Table 1-1. Use a slo-blo, 250V type. The fuse holder is located on the right-front of the power supply assembly. Replace the power cord if required.
- h. Note in a prominent location on the unit that the "operating voltage (has been) changed to _____."

NOMINAL LINE VOLTAGE (TOLERANCE)	SELECTION CARD	FUSE (AMPS)	FREQUENCY (Hz)
100 - (85 - 110)	100	3.0	49-63
120 - (102 - 132)	120	3.0	49-63
208 - (187 - 228)	220	1.5	49-63
220 - (187 - 242)	220	1.5	49-63
230 - (207 - 253)	240	1.5	49-63
240 - (204 - 264)	240	1.5	49-63

Table 1-1. Operating Voltage Selection

INITIAL CHECKOUT

1-5. Section II contains a detailed description of all controls. To check for proper operation before installation, proceed as follows:

- a. Connect power cord.
- b. Clean tape path as directed in paragraphs 4-4 through 4-10.
- c. Apply power to unit and verify that UNLOAD indicator is illuminated. (Allow for normal delay of 5 seconds.) For other indications refer to paragraphs 2-6 and 2-7.
- d. Ensure that tape is wound completely onto reel.

CAUTION

Both top cover and front panel door are locked during tape-loaded functions. Any attempt to open either top cover or front panel door before tape is unloaded will result in mechanical damage to the locking mechanism.

- e. Open front panel door by pressing down gently on top (center) of door.
- f. Insert tape into front panel of unit with write-enable ring side down.
- g. Close front panel door.
- h. Actuate LOAD switch. Access doors are now locked. When load sequence is completed, LOAD indicator will remain illuminated.
- i. Initiate Service Aid 22 as described in paragraphs 3-11 and 3-32. Allow transport to cycle tape for a sufficient length of time to ensure proper servo operation. (It requires about 30 minutes to make a full pass on a 10.5 inch reel and complete a rewind sequence.)
- j. Exit Service Aid 22. Refer to paragraph 3-11.
- k. Check that LOAD indicator remains illuminated following rewind sequence.
- l. Check ON-LINE switch and indicator by depressing repeatedly and observing that ON-LINE indicator is alternately illuminated and extinguished. Leave in off-line state (indicator extinguished).
- m. Press UNLOAD switch. When the tape is unloaded (UNLOAD indicator illuminated) open front panel door and remove tape reel. Close front panel door.
- n. Switch power off and remove power cord from outlet.

RACK MOUNTING

1-6. The CTU is designed to be mounted in a standard, 19-inch-wide, EIA equipment rack using the slides and mounting hardware provided with each unit. Refer to Figure 1-2 and drawing in Installation Hardware Package to mount the unit as follows:

- a. Locate the front and rear rail holes to be used on the equipment rack (1, Figure 1-2). If they are threaded, drill them out to 0.281 inches.
- b. Place the transport in service access position. Refer to paragraph 4-3.
- c. Starting with either side, remove stationary section of slide (2) from transport by pulling stationary section to the front of transport.
- d. Remove intermediate section of slide (3) from transport by pulling intermediate section to the rear of transport. When spring lock engages, depress to release.
- e. Reassemble these sections by sliding front of intermediate section into rear of stationary section. Depress spring lock to slide completely together. Leave these sections assembled.
- f. Determine, for the depth of rack, the appropriate holes to use in the mounting bracket and secure loosely to stationary section using two 10-32 X 3/8 binder head screws (4) and a nut plate (5).
- g. Mount front flange of stationary section (2) to front rail by placing flange behind rack rail holes.
- h. Install two 10-32 X 3/8 binder head screws (6), first through front of rail, then through stationary section flange and secure loosely with a nut plate (7).
- i. Mount mounting bracket to rear of rack by placing flange in front of rack rail holes.
- j. Install two 10-32 X 3/8 binder head screws (8), first through back of rack, then through mounting bracket flange and secure loosely with a nut plate (9).
- k. Check alignment and correct as necessary. Tighten front, rear, and mounting bracket attachment screws.
- l. Repeat steps b through j for other side.
- m. Install the bottom edge of the rack latch bracket (10) on the left rail 2.13 inches below the center-line of slide using two 6-32 X 7/16 flat head screws (11), flat washers (12), split-lock washers (13) and No. 6 hex nuts (14).
- n. Slide intermediate sections forward until locks engage.

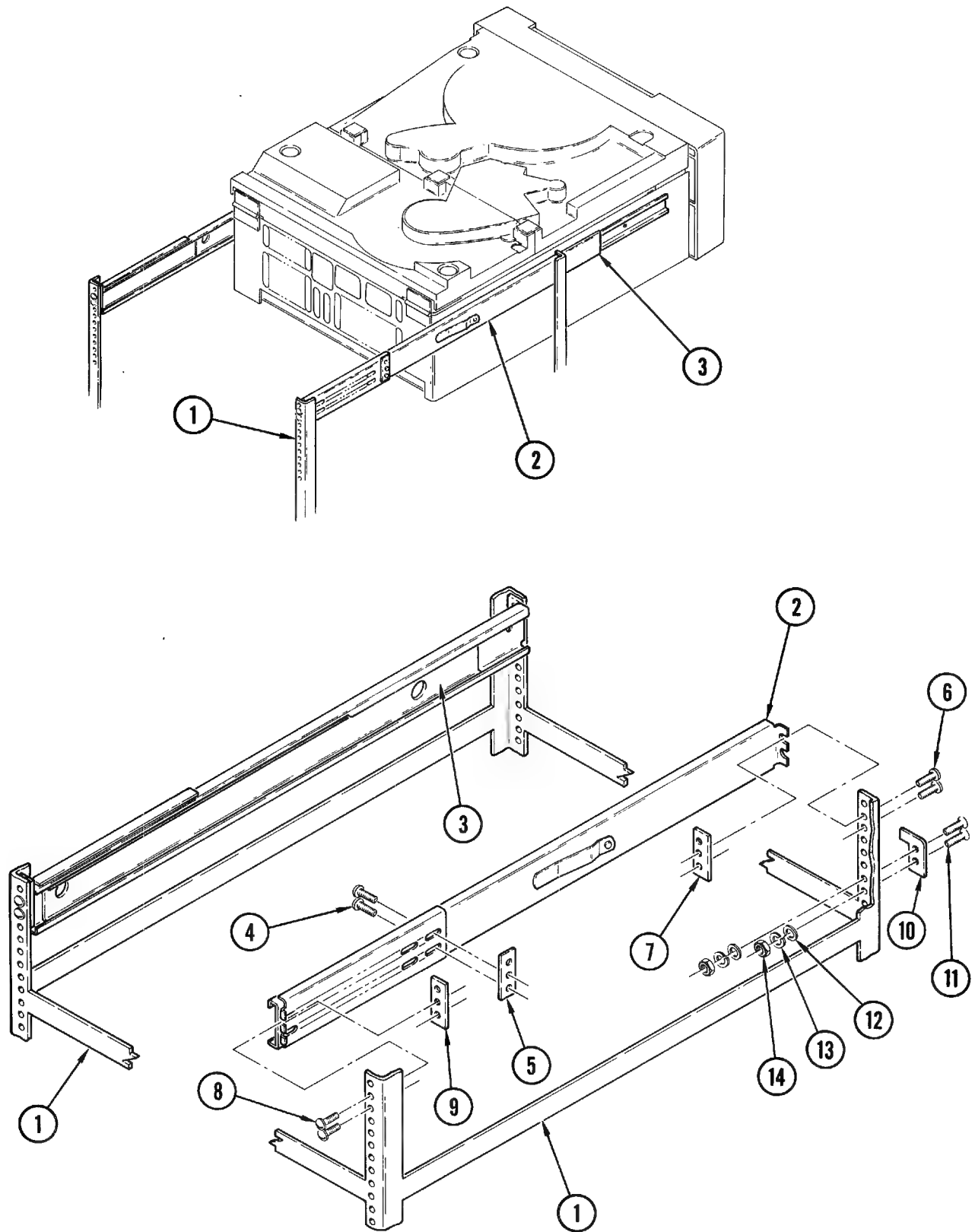


Figure I-2. Rack Mounting

- o. Carefully slide the CTU's transport-attached chassis mount sections (15) into intermediate sections while checking for binding or interference. Release locks and, before closing fully, check that the rack latch will engage securely.
- p. Adjust rack latch bracket (10) or slides as required. To release, squeeze rack latch plate inside air duct opening at lower left of front panel.
- q. Connect the power cord. A service loop must be provided. Ensure the cord will not chafe or interfere with other equipment.

INTERFACE CONNECTIONS

1-7. Single-Transport Systems. Interconnection of the CTU and system equipment should be made with a flat-ribbon cable or harness of individual twisted-pairs. To ensure reliable performance, the cables should have:

- a. A maximum length of 25 feet to include service loop.
- b. 28 AWG conductors for ribbon cable.
- c. 22 or 24 AWG conductors with a 0.01 inch minimum insulation thickness and not less than one twist-per-inch for twisted-pair cables.

1-8. It is important that the alternate conductor in ribbon cable and the ground wires of twisted-pair be grounded at each end of the cable. The CTU will ground its end when connected. Tables 1-3 and 1-4 identify the connector pin assignments for each signal line. The signals indicated "Not Used" are properly terminated by the CTU for bus compatibility. The recommended connectors are:

- a. Ribbon cable - 3M Co. Part No. 3415-0001 (or equivalent).
- b. Twisted-pair cable - Viking Co. Part No. 3VT25/og JNH12 (or equivalent).

Assemble ribbon cable to connector so that it will enter the bottom of the connector when installed on the CTU.

1-9. For flat-ribbon cable, an I/O connector retainer is included with the unit. To install the connectors and retainer:

- a. Open unit to service access position. Refer to paragraph 4-3.
- b. Feed the interconnect cables through the opening at rear of chassis and connect to PWB. Any combination of P1/P2 may be used. See Figure 1-4 (last transport).
- c. Refer to drawing in Installation Hardware Package and install connector retainer inside the chassis using two 10-32 X 1/2 pan head screws and No. 10 flat washers.
- d. Select unit configuration. Refer to paragraph 1-10.

1-10. Integration of the CTU to the System. Refer to Tables 1-2 and 1-5 and local system installation instructions for the U3T and U5W configuration/option switch settings that establish the CTU operating parameters for block size, ramp delay, simulated speed, parity and various options.

1-11. U3T is set to match the performance capability of the CacheTape with the host system. If the configuration switch settings have not been previously established, the optimum operating configuration can be determined as follows:

CAUTION

When changing any U3T configuration switch setting, and prior to loading tape, a "Power-On Reset" must be performed by cycling the front panel power switch to its OFF position, then back to ON. This procedure will allow the CTU processor to update the new U3T switch settings into memory.

- a. Select the 9K block size (U3T-3 and 4 OFF). Refer to paragraphs 1-13, 1-14, and 1-15.
- b. Enable the ramp delay (U3T-5 OFF).
- c. Select the lowest speed (U3T-6, 7 and 8 OFF).
- d. Run an actual tape program or functional tape diagnostic to establish basic compatibility; e.g., measure time to back-up 10 megabytes, as reference.

NOTE

Parametric diagnostics are designed for troubleshooting a particular tape transport and are not indicative of system performance. The best tests of CTU compatibility are the live programs that use the tape sub-system. Functional diagnostics that measure tape system performance are another legitimate tool.

- e. Refer to Table 1-5 and set the next lower or higher block size (U3T-3 and 4), as appropriate, and repeat step d.
- f. Select the next highest speed for increased throughput (U3T-6, 7 and 8).
- g. Repeat steps (d) through (f) until the data rate of the CTU exceeds the data rate capability of the system, as evidenced by data late flags in the host system or a substantial increase in repositioning activity in the CTU (caused by write retries due to incomplete data transfers).
- h. Select the next lowest speed (U3T-6, 7 and 8). Refer to paragraph 1-16.
- i. Disable the ramp delays by closing switch U3T-5. If the data rate of the CTU again exceeds the system throughput rate (ref: step g), return switch U3T-5 to the OFF position (ramps enabled).
- j. U3T-2 is used to select internal parity generation (U3T-2 OFF) or external parity generation (U3T-2 ON). In the external mode, the external parity is compared to the actual internal parity of the data character. If external and internal parity do not agree, a hard error is issued. The CTU does not drop tape tension for this IHER condition.

1-12. The maximum throughput can be determined by running a tape diagnostic and looking for data lates (buffer was empty when request for more data occurred) as the throughput is stepped up (increase in simulated speed). If backups only are run to intelligently integrate the unit, the top cover should be opened by accessing Diagnostic Service Aid 33 (depress TEST/HI-DEN/ON-LINE/ON-LINE/HI-DEN, in sequence). Note that each successive switch depression must be initiated within 3 seconds, or an entry reset will occur. Observe the tape motion as the throughput is stepped up to help assess if there is a cache flow problem evidenced by increased repositioning (ref: step g). If the performance configuration is not matched to the system capability during a backup, the CTU may go into write retries (incomplete data transfers occurring since host cannot output data as fast as requested by cache causes write errors) and drop tape after 16 repositions with error codes 11010 or 11001, excessive write retries. Otherwise, an excessively long backup time compared to a previous run or compared to a start/stop drive is an indication of too high a transfer rate switch setting.

1-13. The lowest possible maximum blocksize should be set, also, so as to not unnecessarily limit throughput by limiting the Cache buffer size. During read, if the maximum block size is set to 32K for a 9K actual block size, the throughput can be degraded by up to 50% compared to reading the same data at the 9K setting. Performance, although good, can be maximized by setting the configuration switches to the lowest maximum block size setting which will contain the actual recorded block size.

1-14. A performance enhancement feature is incorporated to prevent a dropped tape condition in the drive when an attempt is made to write a larger block of data than the maximum block size settings of unit configuration switches U3T-3 and U3T-4. When writing a block of data that exceeds the maximum block size setting, a hard error (IHER) flag is issued to the host and the drive automatically increments to the next higher maximum block size (from 9K to 16K or 16K to 24K, etc.).

CAUTION

IHER will be issued prior to termination of the data transfer. It is the responsibility of the host to issue a normal write retry sequence after recognizing the hard write error condition.

If, during the consequent write retry operation, the data block is still greater than the expanded block size, the drive will continue to increment to the next higher block size with each write retry generated by the host until one of the following events occur:

- a. The data block is successfully written within the limits of the newly expanded maximum block size.
- b. Block size expansion exceeds the 32K limit. In this event, the drive will flag IHER to the host, drop tape, and report hard error code 15 to the front panel.

1-15. The newly expanded final incrementation of maximum block size will remain fixed for the entire remainder of tape or until a system reset is initiated. Therefore, to maintain optimum throughput performance it is important that the operating system maintain reasonable block sizes based on the initial switch settings of U3T-3 and U3T-4. Refer to Table 1-5 for configuration switch settings and to Figure 1-3 for switch locations.

1-16. Note that in many cases the maximum throughput capability of the CacheTape is attained at one or more speed settings below the maximum attainable throughput setting, i.e., the backup time for backing up 10.4 megabytes, in one example, was 3 minutes at the 100, 120, 140, 170 and 200 ips setting. Consequently, the ideal setting would be 100 or 120 ips to eliminate the risk of data transfer problems at the higher speeds. This example is generally an indication of the limits of system throughput (bus activity-speed) and not controller/coupler limitations.

SPECIAL SOFTWARE OPTIONS

1-17. **Special Software Option No. 1 (EOT LOCATION).** This switch selectable feature has been incorporated to allow special EOT Location software users the ability to perform read operations in conformance with the requirements of this software. By placing unit configuration switch U3T-1 in the ON position, the last record placed to tape is written over the EOT mark in order to properly terminate subsequent read operations of a volume by sensing the EOT at the last record to be read. The drive physically locates the EOT mark from a predicted point approximately 25 feet from the physical EOT (impending EOT pointer), locates the last block written, runs forward to EOT, repositions, reverses direction and relocates its tape position back to the correct block location and then proceeds with normal write operations. Cache memory capacity is reduced at this time to assure that the last record accepted from the host is written at EOT. The entire operation requires that the controller time-out be slightly greater than 20 seconds. This routine only occurs once for a full reel of tape (at impending EOT), therefore, degradation of throughput is insignificant. It is suggested that unit configuration switch U3T-1 remain OFF for those users not operating under control of software that requires the physical EOT marker for orderly termination of read operations. Refer to Table 1-5 for configuration switch settings and Figure 1-3 for U3T location.

1-18. **Special Software Option No. 2 (Post-EOT Streaming Operation).** This switch selectable option will allow the CTU to operate with operating systems designed for certain older conventional start/stop drives. This older software contained a special time-out that was set upon encountering the EOT marker. The time-out was necessary to prevent the "dumb" tape transport from writing completely off the end of tape, requiring operator intervention to manually reload the end of tape and rewind the tape reel. The option may be switch selected by placing switch U5W-4 in the ON position (refer to Figure 1-3). It is suggested that switch U5W-4 remain in the OFF position for those users not operating under control of this older type of software/transport emulation.

1-19. Special Software Option No. 3 (3200 BPI IDENT Status). Some software and couplers require the absence of IDENT status when operating from load point, regardless of the existence of the ID burst (as in the case of 3200 BPI operation due to a past convention). To implement this option, place switch U5W-5 in the ON position. When operating from load point, this option will cause the IDENT interface status line to not be asserted when 3200 BPI density is selected (refer to Table 2-1, HI-DEN switch). As with all other switch selectable options, this switch setting should remain in the OFF position unless otherwise necessary for proper operation of the CTU. In this mode (OFF), IDENT status will be asserted for 3200 BPI operation at all times (per ANSI standards).

1-20. Parity Selection. The user may select either internal parity generation or external parity (host provided) by the appropriate selection of unit configuration switch U3T-2. With U3T-2 in the OFF or OPEN position, parity of the IWO through IW7 data lines is determined internally by the CTU. When U3T-2 is in the ON or CLOSED position, the CTU accepts the proper parity (always odd) from the host on the parity line, IWP. If the host parity is in disagreement with the CTU's internally derived parity, a non-catastrophic hard error will be reported to the host for the specific character being written, and the correct parity will be toggled on the IRP line.

MULTIPLE-TRANSPORT OPERATION

1-21. Daisy Chaining. Up to eight transports may be operated from the host system (if capable) and can include combinations of CTU's, Microstreamers and embedded formatter tape transports. Transport to transport interconnect cables must meet the same criteria as for single transport operation. The total cable length from the host system to the last physical transport (or embedded formatter) must not exceed 25 feet unless active repeaters are used. See Figures 1-5 and 1-6 for daisy chain combinations.

To configure the CTU to operate on a multiple-transport system, proceed as follows:

- a. Open CTU to service access position. Refer to paragraph 4-3.
- b. Remove terminator resistor packs U3W and U10W (Figure 1-4) from each transport except last unit.
- c. Install interconnect cables. Refer to paragraph 1-9.
- d. Select unit address. Refer to paragraph 1-22.
- e. Select unit configuration. Refer to paragraph 1-10.

1-22. **Unit Address Select.** The CTU is selected by a combination of the levels on the IFAD, ITAD0, and ITAD1 signal lines and the position of U5W switches 1, 2 and 3. Note that U5W is set for address 0 from the factory. Refer to Table 1-2 for unit address select switch settings.

SWITCH	POSITION			FUNCTION	
U5W	1 TAD0*	2 TAD1*	3 FAD*	Unit Address Select	
	ON	ON	ON	FAD0*	0
	ON	OFF	ON		1
	OFF	ON	ON		2
	OFF	OFF	ON		3
	ON	ON	OFF	FAD1*	4
	ON	OFF	OFF		5
	OFF	ON	OFF		6
	OFF	OFF	OFF		7
	4-6			NOT USED	
	7	ON		Post-EOT STREAMING enabled	
	7	OFF		Post-EOT STREAMING disabled	
	8	ON		3200 BPI IDENT enabled	
	8	OFF		3200 BPI IDENT disabled	

Table 1-2. Unit Address Select/Option Switch

NOTE

CacheTape and Microstreamer drives should not be connected to conventional embedded formatter drives on the same FAD line logic level; e.g., if a CTU is set for any address between 0 and 3, the conventional drive must be set for an address between 4 and 7.

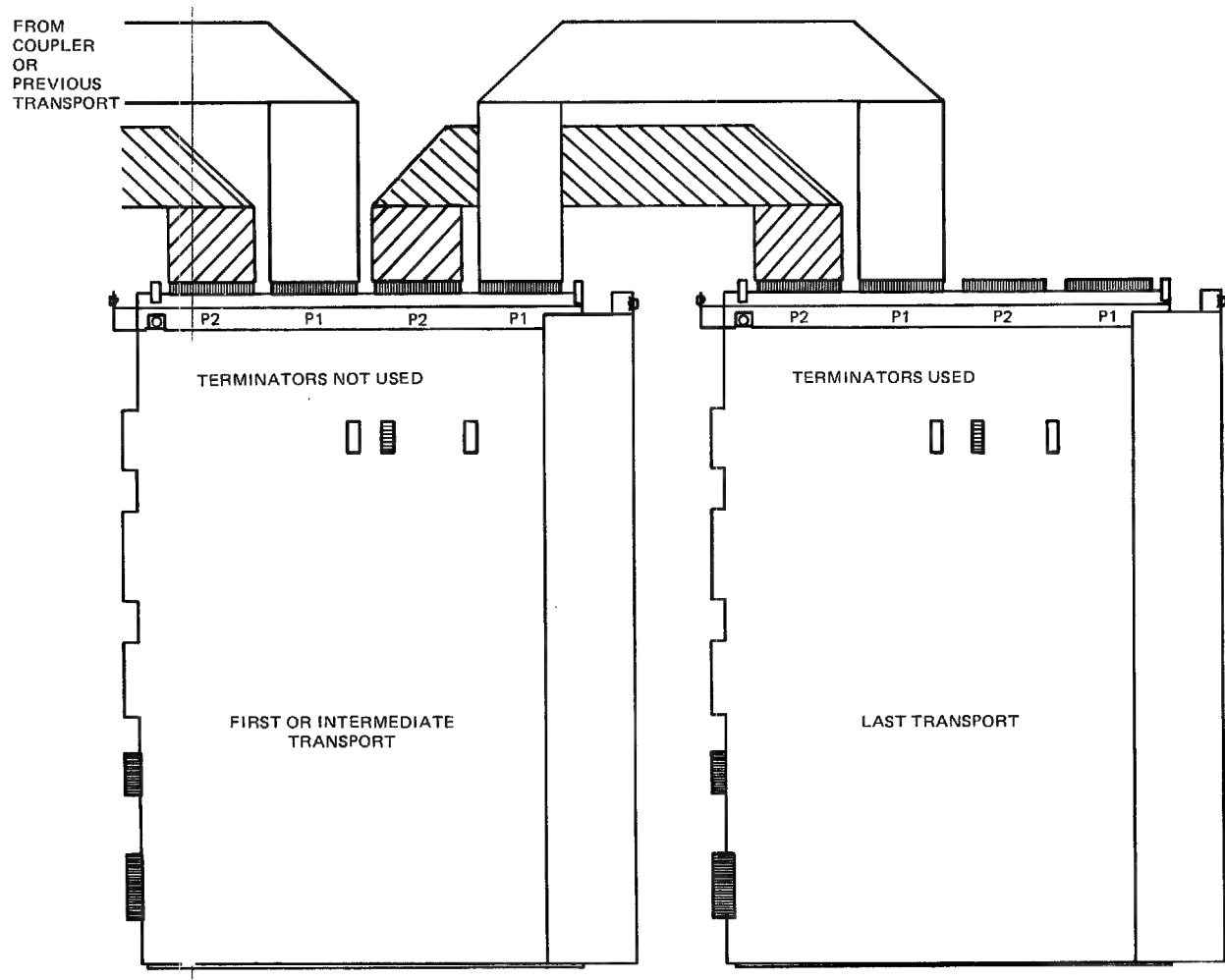


Figure I-4. Daisy Chain Cable Configuration

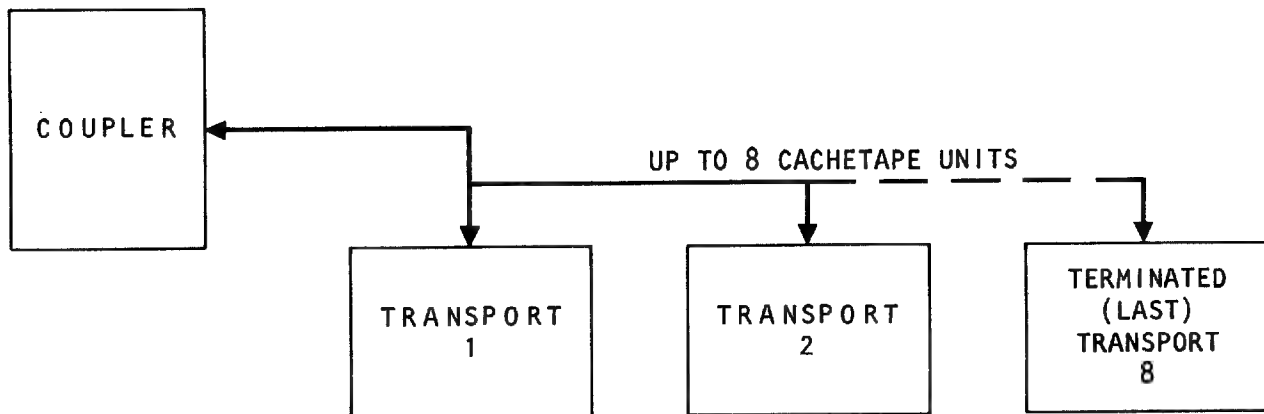


Figure I-5. Daisy Chain Configuration

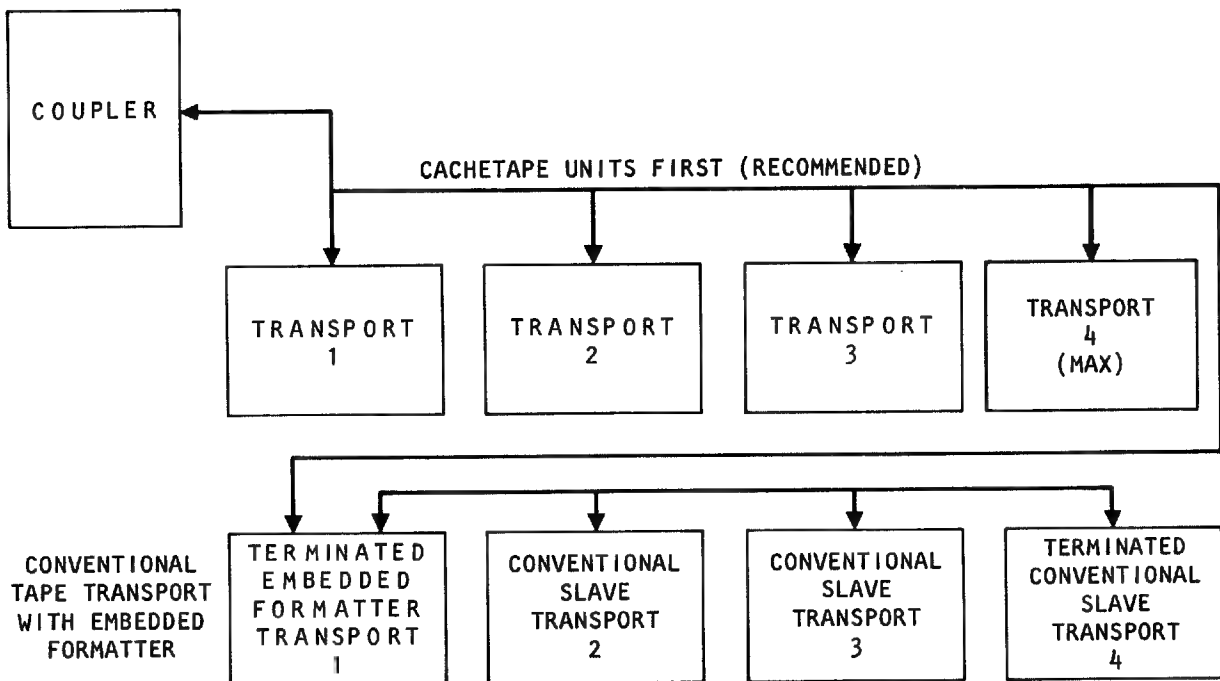


Figure I-6. Hybrid Daisy Chain with CacheTape and Embedded Formatter Drives

PLUG NO.	LIVE PIN	GROUND PIN	SIGNAL DESCRIPTION	SIGNAL NAME
P1	4	3	Last Word	ILWD
P1	6	5	Write Data 4	IW4
P1	8	7	Initiate Command	IGO
P1	10	9	Write Data 0	IW0
P1	12	11	Write Data 1	IW1
P1	14	13	(Not Used)	(ISGL)
P1	16	15	(Not Used)	(ILOL)
P1	18	17	Reverse	IREV
P1	20	19	Rewind	IREW
P1	22	21	Write Data Parity	IWP
P1	24	23	Write Data 7	IW7
P1	26	25	Write Data 3	IW3
P1	28	27	Write Data 6	IW6
P1	30	29	Write Data 2	IW2
P1	32	31	Write Data 5	IW5
P1	34	33	Write	IWRT
P1	36	35	(Not Used)	(IRTH2)
P1	38	37	Edit	IEDIT
P1	40	39	Erase	IERASE
P1	42	41	Write File Mark	IWFM
P1	46	45	Transport Address 0	ITAD0
P2	18	17	Formatter Enable	IFEN
P2	24	23	Rewind/Unload	IRWU
P2	46	45	Transport Address 1	ITAD1
P2	48	47	Formatter Address	IFAD
P2	50	49	(Not Used)	(IHISP)

Table I-3. Interface Signals, Controller to Transport

PLUG NO.	LIVE PIN	GROUND PIN	SIGNAL DESCRIPTION	SIGNAL NAME
P1	2	1	Formatter Busy	IFBY
P1	44	43	(Not Used)	(IRTH1)
P1	48	47	Read Data 2	IR2
P1	50	49	Read Data 3	IR3
P2	1	-	Read Data Parity	IRP
P2	2	-	Read Data 0	IR0
P2	3	-	Read Data 1	IR1
P2	4	-	Load Point	ILDLP
P2	6	5	Read Data 4	IR4
P2	8	7	Read Data 7	IR7
P2	10	9	Read Data 6	IR6
P2	12	11	Hard Error	IHER
P2	14	13	File Mark	IFMK
P2	16	15	Identification	IIDENT
P2	20	19	Read Data 5	IR5
P2	22	21	End of Tape	IEOT
P2	26	25	(Not Used)	(INRZ)
P2	28	27	Ready	IRDY
P2	30	29	Rewinding	IRWD
P2	32	31	File Protect	IFPT
P2	34	33	Read Strobe	IRSTR
P2	36	35	Write Strobe	IWSTR
P2	38	37	Data Busy	IDBY
P2	40	39	(Not Used)	(ISPEED)
P2	42	41	Corrected Error	ICER
P2	44	43	On Line	IONL

Table I-4. Interface Signals, Transport to Controller

SWITCH	POSITION			FUNCTION		
U3T	1 ON			EOT LOCATION enabled		
	1 OFF			EOT LOCATION disabled		
	2 ON			External Parity		
	2 OFF			Internal Parity		
	3	4		Select max. block size		
	OFF	OFF		9K bytes		
	ON	OFF		16K bytes		
	OFF	ON		24K bytes		
	ON	ON		32K bytes		
	5 OFF			Enable ramp delay		
	5 ON			Disable ramp delay		
	6	7	8	Selected Simu- lated Speed -IPS- (Avg & Min/Max)	Data Burst Transfer Rate -KBS- (Avg & Min/Max)	Ramp Delay -msec- (Enabled)
	OFF	OFF	OFF	45	72	8.3
	ON	OFF	OFF	75	120	5.0
	OFF	ON	OFF	100	160	3.7
	ON	ON	OFF	112 (103/120)	180 (165/192)	3.0
	OFF	OFF	ON	125 (108/140)	200 (172/225)	2.6
	ON	OFF	ON	155 (138/170)	250 (220/272)	2.2
	OFF	ON	ON	185 (160/206)	295 (256/330)	1.5
	ON	ON	ON	250 (200/300)	400 (320/480)	1.0

Table I-5. Configuration Switches

COMMANDS

1-23. The basic transport commands are derived by decoding the REVERSE, WRITE, WRITE FILE MARK, EDIT, and ERASE interface lines. When a command is issued to the transport from the controller, the transport asserts the IFBY line (true state) and performs all timing and control functions necessary for the execution of the command.

1-24. The command lines are transferred to the command registers on the trailing edge of the IGO pulse. Any errors occurring during the execution of the command are reported to the controller via the IHER or ICER interface lines. Upon completion of the command, the IDBY interface line goes false, notifying the controller that it may issue another command. All acceptable combinations of the interface lines are listed in Table 1-6. The interface lines used for command decoding are defined as follows:

- a. Reverse (IREV). This is a level which, when true, specifies reverse tape motion and, when false, specifies forward tape motion.
- b. Write (IWRT). This is a level which, when true, specifies the write mode of operation, and when false, specifies the read mode of operation.
- c. Write File Mark (IWFM). This is a level which, when true and IWRT is also true, causes a file mark to be written on the tape.
- d. Edit (IEDIT). When this level is true and IWRT is true, the transport operates in the edit mode.
- e. Erase (IERASE). This is a level which, when true in conjunction with a true level on the IWRT line, causes the transport to execute an erase variable length command. The transport will be conditioned to execute a normal write command but no data will be recorded. A length of tape, as defined by ILWD, will be erased. Alternately, if IERASE, IWRT, and IWFM command lines are true, the transport is conditioned to execute a fixed length erase command. A fixed length of tape of approximately 4 inches will be erased. When command lines IWRT, IWFM, IEDIT, and IERASE are true, the transport is conditioned to execute a security erase operation. A length of tape, from the point where the command was issued to five feet beyond EOT, will be erased. The following are the commands that can be executed by the CTU. These commands are strobed by IGO.

1-25. **Read.** The CTU reads data records or file marks in either a forward or reverse direction, generating output data (eight data lines plus parity) and read data strobes to the controller. A read forward operation will be terminated if it occurs more than 15 feet beyond EOT. This prevents further transport operation, which could cause the tape to run off the supply reel. A read reverse operation into loadpoint will clear the formatter. Recovery threshold is automatically lowered during a read operation in order to provide additional reliability. The write threshold is nominally 25%, while the read threshold is set at an approximate 10% level for normal operation. If a read error is detected, a read retry sequence is automatically initiated, transparent to the host. During the resulting retry sequence, the read threshold is lowered further (approximately 2% additional for each successive retry) until a maximum of four (4) retries have been attempted. IHER is issued to the interface after four unsuccessful retry attempts.

1-26. **Space** (Forward and Reverse). This operation is identical to a standard Read, except that Read Strobe and error flags are not generated. This command will space one record either forward or reverse.

1-27. **File Search.** This signal initiates a space operation in either the forward or the reverse direction. The read data lines may be deactivated during file search operation, thereby ignoring any data that is written on the tape. The File Search command is terminated when:

- a. A file mark is encountered.
- b. Load point is encountered in a reverse direction.
- c. The formatter is externally cleared.
- d. The tape is past EOT by 15 feet or more.

1-28. **Write** (Forward only). The CTU starts tape and generates the proper delay before transferring the data character, ensuring the generation of ANSI/IBM compatible inter-record gaps and ID burst for PE. When writing in 1600 bpi mode from load point, the tape drive always generates the required PE identification burst. When IDBY goes true, it indicates that the first IWSTR (write strobe) will occur no sooner than 40 character intervals later. The write operation continues until ILWD (Last Word) is received by the transport, which indicates the last character in the data block.

1-29. True write operations (not erase) generate an automatic read verification with the signals activated as in read commands, except that signal thresholds are higher (25%). If the read-after-write verification operation detects a write error on the tape, an automatic write retry sequence is initiated. The block in error plus an additional 0.2 inches of tape are erased and the record is re-written. This procedure will be repeated until the record is successfully written without error for up to sixteen (16) retries, transparent to the host, at which time a hard error (IHER) will be issued, tape motion will stop and error code 11 or 21 will be displayed on the front panel. Refer to Table 3-6.

1-30. The following are two variations of the basic write operation:

- a. **Edit.** This signal is identical to the basic write operation, except that erase and write head currents are sequenced on to overlap the record being rewritten. This operation should be preceded by a read reverse or read reverse edit command to position the head in front of the block being edited. A block should be edited no more than three times to ensure proper gap spacing.
- b. **Write File Mark.** This signal generates the compatible file mark and produces a (4.0 inch) IRG gap. The read file mark circuitry is activated. If a file mark status is not returned, the file mark should be backspaced and rewritten. File mark identification is reliable, since it is recovered by means of majority gating. All required and optional tracks are written with 80 transitions (40 characters) of 0's. Channels 1, 3, and 4 are DC erased.

1-31. **Erase.** This signal produces an erase field at the head with no data flux transitions. There are three variations to this command, as follows:

- a. **Erase Fixed Length:** Erases fixed length of tape (4 inches).
- b. **Erase Variable Length:** Continuous erasure until terminated by the controller. Length is determined by the last character flag used in a normal write operation.
- c. **Security Erase:** Erase forward to EOT and five feet beyond. No status lines are activated; other transports may be selected while a SECURITY ERASE is occurring. It is not necessary to wait for IFBY to drop before selection of another transport, but it is preferable to wait for IDBY. The transport may also be commanded to rewind after completion of SECURITY ERASE simply by issuing a REWIND. The transport will indicate an immediate rewinding status, dropping the IDBY, IRDY, and IFBY, but will complete SECURITY ERASE and a REWIND automatically. Other transports may be selected and used during execution of these commands.

1-32. **Write Synchronize.** This command is used to ensure that all pending writes are complete. Following issuance of this command, IDBY remains set until the entire contents of the cache is written on tape.

1-33. **3200 BPI.** This is a command (3200 CPI model only) which, when initiated while at the BOT marker, specifies the 3200 bpi mode of operation.

1-34. **1600 BPI.** This is a command which, when initiated while at the BOT marker, specifies the 1600 bpi mode of operation.

1-35. **Read Extended Drive Status.** Extended drive status is available to the host in the form of four (4) independently accessible records containing up to sixteen (16) bytes each. Extended status can only be read when the drive is ON-LINE. To access one of the 16 byte records the host must first issue the Read Extended Status command, which is "00010" = EDIT (refer to Table 1-6). The command is accompanied by the usual IGO pulse. This command places the drive in the Extended Status Mode whereby the drive will wait for a second "ACCESS" command, accompanied by IGO. This second command, or Block Access Code, selects the appropriate 16 byte block to be transferred to the host as a normal read operation on the IRO-IR7 data lines, complete with read strobes. Should more than one record be desired, the Read Extended Status command/IGO pulse may be re-issued and the appropriate block access code asserted on the five command lines, accompanied by the IGO pulse. The new status block will then be strobed to the interface.

1-36. The Error History Block may be reset to zero if the block access code is "10011." A description of the information provided by the Read Extended Status command is given in Table 1-7.

1-37. **Write Edit.** This command can be used to re-write an existing data block on tape. The command is 01010 = EDIT, WRITE. The use of this command has certain restrictions. First, the user must be positioned at the start of a valid data block via a space reverse or read reverse operation. If these conditions are not met, then an illegal command 7 code will result. Next, the block size transferred to replace the old block must not exceed the original block byte count. The block size may be less if the user can assure that the post-block gap will erase any old data. If the newly written block is greater than the old block, fault code 10 will result (refer to Table 3-6).

COMMAND	(LSB) REVERSE	WRITE	WRITE FILEMARK	EDIT	(MSB) ERASE
Read Forward	0	0	0	0	0
Read Reverse	1	0	0	0	0
Read Reverse Edit	1	0	0	1	0
Write	0	1	0	0	0
Write Edit	0	1	0	1	0
Write File Mark	0	1	1	0	0
Erase Variable Length	0	1	0	0	1
Erase Fixed Length	0	1	1	0	1
Security Erase	0	1	1	1	1
Space Forward	0	0	0	0	1
Space Reverse	1	0	0	0	1
File Search Forward	0	0	1	0	0
File Search Forward (Ignore Data)	0	0	1	0	1
File Search Reverse	1	0	1	0	0
File Search Reverse (Ignore Data)	1	0	1	0	1
Write Sync	0	0	0	1	1
3200 bpi*	1	0	1	1	1
1600 bpi (PE)	0	0	1	1	1
Read Extended Status	0	0	0	1	0
Current Status	0	0	0	0	0
Configuration Status	1	0	0	0	0
Error History Status	0	0	0	1	0
Machine Status	1	0	0	1	0
Error History Reset	1	0	0	1	1

*Product Option

Table I-6. Command Decoding

BYTE NO.	BIT*	CONTENTS
		CURRENT STATUS BLOCK ACCESS CODE - 00000
0		<u>TAPE STATUS BYTE #1</u>
	0	IDENT
	1	IHER
	2	ICER
	3	IFMK
	4	IRDY
	5	IONL
	6	IRWD
1	7	IFPT
		<u>TAPE STATUS BYTE #2</u>
	0	ILDPT
	1	IEOT
	2	READ RETRIES EXCEEDED
	3	WRITE PARITY ERROR AT INTERFACE
	4	WRITE HARD ERROR
	5	ILLEGAL COMMAND
2	6	
	7	
		<u>ERROR CLASSIFICATION</u>
	0	} CACHE AUTO-EXPANDED {
	1	
	2	
	3	READ FROM TAPE TO CACHE OVERRUN
	4	WRITE FROM HOST TO CACHE OVERRUN
	5	
3	6	
	7	
		<u>TRACK IN ERROR</u>
	0	TRACK 7 IN ERROR
	1	TRACK 6 IN ERROR
	2	TRACK 5 IN ERROR
	3	TRACK 4 IN ERROR
	4	TRACK 3 IN ERROR
	5	TRACK 2 IN ERROR
	6	TRACK 1 IN ERROR
	7	TRACK 0 IN ERROR

* BIT 0 = LSB; BIT 7 = MSB, UNLESS OTHERWISE SPECIFIED

Table I-7. Read Extended Status

BYTE NO.	BIT*	CONTENTS
		CURRENT STATUS BLOCK (Cont'd) ACCESS CODE 00000
4	0 1 THRU 7	TRACK P IN ERROR LSB } READ/WRITE RETRY COUNT ON MSB } CURRENT HOST RECORD
5	0 THRU 4	LSB } FRONT PANEL ERROR CODE MSB }
6	0 1 2 3 4 5 6 7	DENSITY CODE DENSITY FOUND/OPERATING DENSITY (BPI): 000 = 800 001 = 1600 010 = 3200 011 = 6250 DENSITY REQUESTED: 000 = 800 001 = 1600 010 = 3200 011 = 6250 READ DENSITY CONFLICT WRITE DENSITY CONFLICT
7	0 THRU 7	UNFIXED BLOCK COUNT (INCLUDES FILE MARKS) BLOCK DETECTABLE STRUCTURES REMAINING IN CACHE
8		FIXED BLOCK COUNT FROM BOT (INCLUDES FILE MARKS) LOW ORDER BYTE
9		MID ORDER BYTE
10		HIGH ORDER BYTE
11		SEQUENCE NUMBER OF RECORD IN HARD ERROR LOW ORDER BYTE
12		MID ORDER BYTE
13		HIGH ORDER BYTE

Table 1-7. Read Extended Status (Continued)

BYTE NO.	BIT*	CONTENTS
		CONFIGURATION STATUS BLOCK ACCESS CODE 01111
0		<u>CAPABILITY</u>
	0	800 BPI
	1	1600 BPI 0 = DO NOT HAVE CAPABILITY
	2	3200 BPI 1 = DO HAVE CAPABILITY
	3	6250 BPI
	4	OTHER
1		<u>VENDOR CODE</u>
2		<u>MODEL CODE</u>
	0	} 000 = OTHER 011 = M891-I 110 = M990-II
	1	
	2	
	3	
	THRU 7	001 = M890-I 100 = M891-II 111 = M991-HPGCR 010 = M890-II 101 = M990-I
3		<u>CONFIGURATION STATE</u>
	0	EOT LOCATION-- 1 = EOT SEARCH, 0 = STD. (U3T-1)
	1	PARITY-- 1 = EXTERNAL, 0 = INTERNAL (U3T-2)
	2	} MAX. BLK. 00 = 9K 10 = 24K (U3T-3)
	3	
	4	} SIZE 01 = 16K 11 = 32K (U3T-4)
	5	
	6	RAMPS-- 1 = DISABLED, 0 = ENABLED (U3T-5)
	7	LSB } SIMULATED SPEED SETTING (U3T-6)
		MSB } (U3T-7)
		(U3T-8)
4		<u>SOFTWARE CONFIGURATION</u>
	0	
	1	
	2	
	3	POST-EOT STREAMING (U5W-4)
	4	3200 BPI IDENT (U5W-5)
	5	
	6	
	7	

Table 1-7. Read Extended Status (Continued)

BYTE NO.	BIT*	CONTENTS
		ERROR HISTORY BLOCK ACCESS CODE - 00010
0		<u>READ RETRY COUNT - SINCE UNLOAD (255 MAX)</u>
1		<u>WRITE RETRY COUNT - SINCE UNLOAD (255 MAX)</u>
		<u>TRACK HISTORY - ERROR COUNTS PER TRACK (255 MAX)</u>
2		TRACK 0
3		TRACK 1
4		TRACK 2
5		TRACK 3
6		TRACK 4
7		TRACK 5
8		TRACK 6
9		TRACK 7
10		TRACK P
		MACHINE STATUS BLOCK ACCESS CODE - 10010
		<u>HEAD POS'N/TACH COUNT IN MULTIPLES OF 1.28 INCHES</u>
0		LOW ORDER BYTE OF TACH COUNT
1		HIGH ORDER BYTE OF TACH COUNT
		<u>LOGICAL COMMAND HISTORY</u>
2		PREVIOUS HOST COMMAND
3		2ND PREVIOUS HOST COMMAND
4		3RD PREVIOUS HOST COMMAND
5		4TH PREVIOUS HOST COMMAND
6		5TH PREVIOUS HOST COMMAND
7		<u>OPERATING STATUS</u>
	0	} REEL SIZE: 00 = UNKNOWN 01 = 7 INCH 10 = 8-1/2 INCH 11 = 10-1/2 INCH DOOR LOCK STATUS: 0 = UNLOCKED 1 = LOCKED
	1	
	2	

Table I-7. Read Extended Status (Continued)

SECTION II

OPERATION

GENERAL

2-1. This section describes the controls and indicators of the CTU and provides operating instructions.

CONTROLS AND INDICATORS

2-2. Control/indicator types, functions, and the conditions required for enabling the corresponding functions are given in Table 2-1. Figure 2-1 shows the controls and indicators.

LOADING TAPE

2-3. To load tape, proceed as follows:

CAUTION

Do not attempt to open either top cover or front-panel door during load operation or while tape is loaded in transport. Both front-panel door and top cover are locked during tape-loaded functions.

- a. Apply power to unit and verify that UNLOAD indicator is illuminated. (Allow for normal delay of 5 seconds.)
- b. Prepare tape-leader, if required, using Cipher tool Part No. 209990-500.
- c. Verify that write-enable ring, if used, is fully seated.
- d. Ensure that tape is wound completely onto reel.
- e. Open front-panel door by pressing down gently on top (center) of door.
- f. Insert tape into front of unit with write-enable ring side down. Tip edge of reel inside unit upward slightly to clear supply hub and place tape well inside unit. The door, when closed, should not touch the reel.

- g. Close front-panel door.
- h. Actuate LOAD switch. Access doors are now locked. When load sequence is completed, LOAD indicator will remain illuminated.

NOTE

During load sequence, actuation of ON LINE switch will place transport on line when BOT marker is sensed.

CONTROL/ INDICATOR	TYPE	FUNCTION	CONDITIONS
POWER	ON/OFF Rocker Switch and Indicator	Switches line power on and off.	Fuse installed. Line cord connected.
LOAD REWIND	Tactile Switch and Indicator	Loads tape to BOT marker.	Tape inserted in front panel door. Top cover and front panel door closed.
		Rewinds tape to BOT marker. Illuminates to indicate BOT tab is logically positioned at photosensor. When flashing, transport is executing a load or a rewind sequence.	Transport in off-line mode (ON-LINE indi- cator extinguished).
UNLOAD	Tactile Switch and Indicator	Unloads tape from any point. UNLOAD indicator flashes during unload se- quence, then remains illuminated.	Transport in off-line mode. (ON-LINE in- dicator extinguished).

Table 2-1. Controls and Indicators

CONTROL/ INDICATOR	TYPE	FUNCTION	CONDITIONS
ON-LINE	Tactile Switch and Indicator	Switches transport to on-line mode. Illuminates to indicate transport is on line.	Tape loaded and transport in off-line mode (ON-LINE indicator extinguished).
		Second actuation switches transport off-line. Indicator extinguished to indicate transport is off line.	Transport is in on-line mode. (ON-LINE indicator illuminated.)
TEST	Tactile Switch	Selects alternate operational mode for other switches.	Refer to paragraphs 3-2 and 3-8.
WRT EN (Write Enable)	Indicator	Illuminates to indicate write function may be performed.	Tape reel write-enable ring installed mounted on supply hub and tape loaded.
HI DEN	Tactile Switch and Indicator	First actuation (indicator illuminated): high density mode, 3200 CPI.	3200 CPI transport must be in off-line mode (ON-LINE indicator extinguished).
		Second actuation (indicator extinguished): lower density mode, 1600 CPI.	
		Indicator also reflects the density selected via the I/O command.	

Table 2-1. Controls and Indicators (Continued)

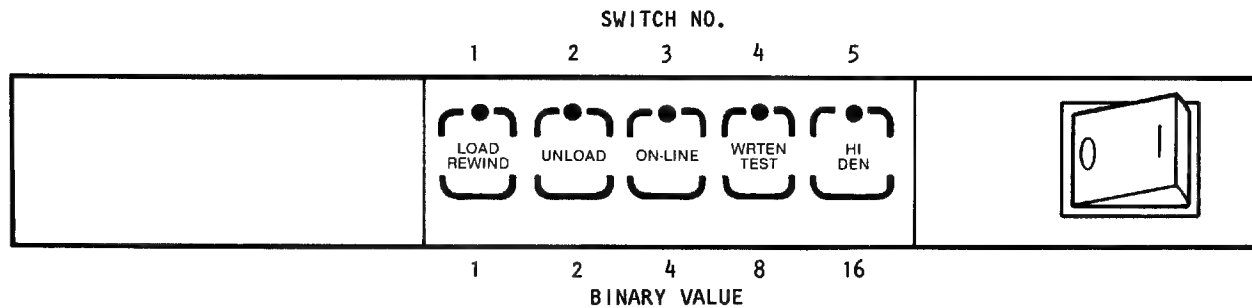


Figure 2-1. Control Panel

UNLOADING TAPE

2-4. To unload tape, proceed as follows:

- a. Actuate UNLOAD switch. Transport must be in off-line mode (ON-LINE indicator extinguished).

NOTE

During the unload sequence, UNLOAD indicator will flash and access doors will remain locked. When the unload sequence is completed, UNLOAD indicator will remain illuminated and access doors will unlock.

- b. Open front-panel door when UNLOAD indicator remains illuminated.
- c. Carefully lift up the reel to clear the supply hub and remove.
- d. Close front-panel door.

ERROR CONDITIONS

2-5. Operating failures or fault conditions are indicated by various front panel display patterns. There are two groups of fault indications: those which are normally caused by the tape or operator and can be avoided by following the proper operating procedure, and those which are machine malfunctions and require correction by an experienced service technician.

2-6. **Operator Error Codes.** These fault indications occur during normal tape loading operation. They produce error codes which will be displayed as an even, ON/OFF pattern of the indicators on the front panel. Refer to Table 2-2. When the problem is corrected (i.e., closing the front panel door) actuate the LOAD switch to clear the error condition and re-enter the load sequence. If these error codes occur when proper operating procedures have been followed, a machine malfunction is indicated.

2-7. **Transport Error Codes.** These faults indicate a serious deviation from the normal operating routine of the CTU. Each fault code is represented as a unique binary pattern of the front panel indicators, which flash a quick double-pulse to alert the operator. These faults inhibit the CTU and require correction by a service technician. They can be cleared only by turning the power off. Refer to Section III, Table 3-6 for these fault codes and troubleshooting instructions.

ERROR CODE*	INDICATION	CONDITIONS
22	All indicators except LOAD and TEST flashing	Early EOT marker encountered. EOT marker located greater than 25 feet prior to actual EOT. Used with switch U3T-1 "ON" only. Relocate EOT marker.
23	All indicators except TEST flashing	A load operation was attempted without inserting a tape reel into the transport, the reel of tape is not properly seated, or the supply reel was not locked when attempting a manual load. Check if file protect and hub seat sensor are working properly. Attempt another LOAD operation.
25	All indicators except UNLOAD and ON-LINE flashing	An insufficient amount of tape was wrapped around the takeup hub when attempting a manual load. A minimum of five wraps is required.
26	All indicators except LOAD and ON-LINE flashing	Tape end did not peel off of reel. Remove antistatic tape/foam block if used. If caused by static charge buildup, refer to paragraph 2-8 for manual load instructions.
27	All indicators except ON-LINE flashing	A load or unload operation was attempted with the front-panel door or top cover in the open position.
28	All indicators except LOAD and UNLOAD flashing	Tape reel prevented movement of the supply reel hub. Remove and re-insert tape reel to clear.
29	All indicators except UNLOAD flashing	Tape reel was inserted upside-down. The bottom of the tape reel is identified by the write-enable ring groove or the write enable ring (when installed) near the inside mounting circumference.
30	All indicators except LOAD flashing	The BOT marker was not detected within the first 35 feet of tape. The leader must be a minimum of 6 feet in length.
31	All indicators flashing	After four attempts, the CTU did not successfully complete the load sequence. The tape leader should be checked for excessive damage or static charge buildup. If a second attempt at autoloading fails, refer to paragraph 2-8 for manual load instructions.

*Error code number is the decimal equivalent of the front panel binary indication (LSB-left, MSB-right).

Table 2-2. Operator Error Front Panel Indications

MANUAL LOAD

- 2-8. To load tape after a failure of the autoloading routine, proceed as follows:
- a. Extend unit on its slides to clear equipment rack.
 - b. Place transport in operator maintenance access position by lifting top cover sides behind front panel. Place cover stay in slot provided.
 - c. Place reel of tape on supply hub. Ensure that reel is evenly seated on hub.
 - d. Depress and hold the manual unlock button, located behind front-panel door on bottom left hand side of tape reel opening, and simultaneously rotate the supply hub clockwise until supply reel is locked in place.
 - e. Thread tape along path shown in Figure 2-2. Carefully move tachometer assembly away from takeup hub, and, making one wrap of tape clockwise around takeup hub, gently replace tachometer assembly. Continue to wrap tape for FIVE (5) more revolutions of the takeup hub. Check that tape is seated correctly on guides and threaded properly over head assembly.
 - f. Close top cover, and place transport in normal operating position.
 - g. Depress and hold the HI DEN switch, then actuate the LOAD switch and release both. Tape should tension and advance forward until BOT tab is positioned at photosensor. LOAD indicator will illuminate, indicating that CTU is ready for use.

MANUAL UNLOAD

- 2-9. If for any reason the CTU cannot complete the rewind/unload sequence, the tape reel may be rewound manually as follows:
- a. Place transport in operator maintenance access position. Refer to paragraph 4-2.
 - b. Rotate supply reel in counterclockwise direction to rewind tape onto supply reel.
 - c. Depress and hold the manual unlock button, located behind front-panel door on bottom left hand side of tape reel opening, and simultaneously rotate the supply reel counterclockwise until it rotates freely and can be removed from the transport.

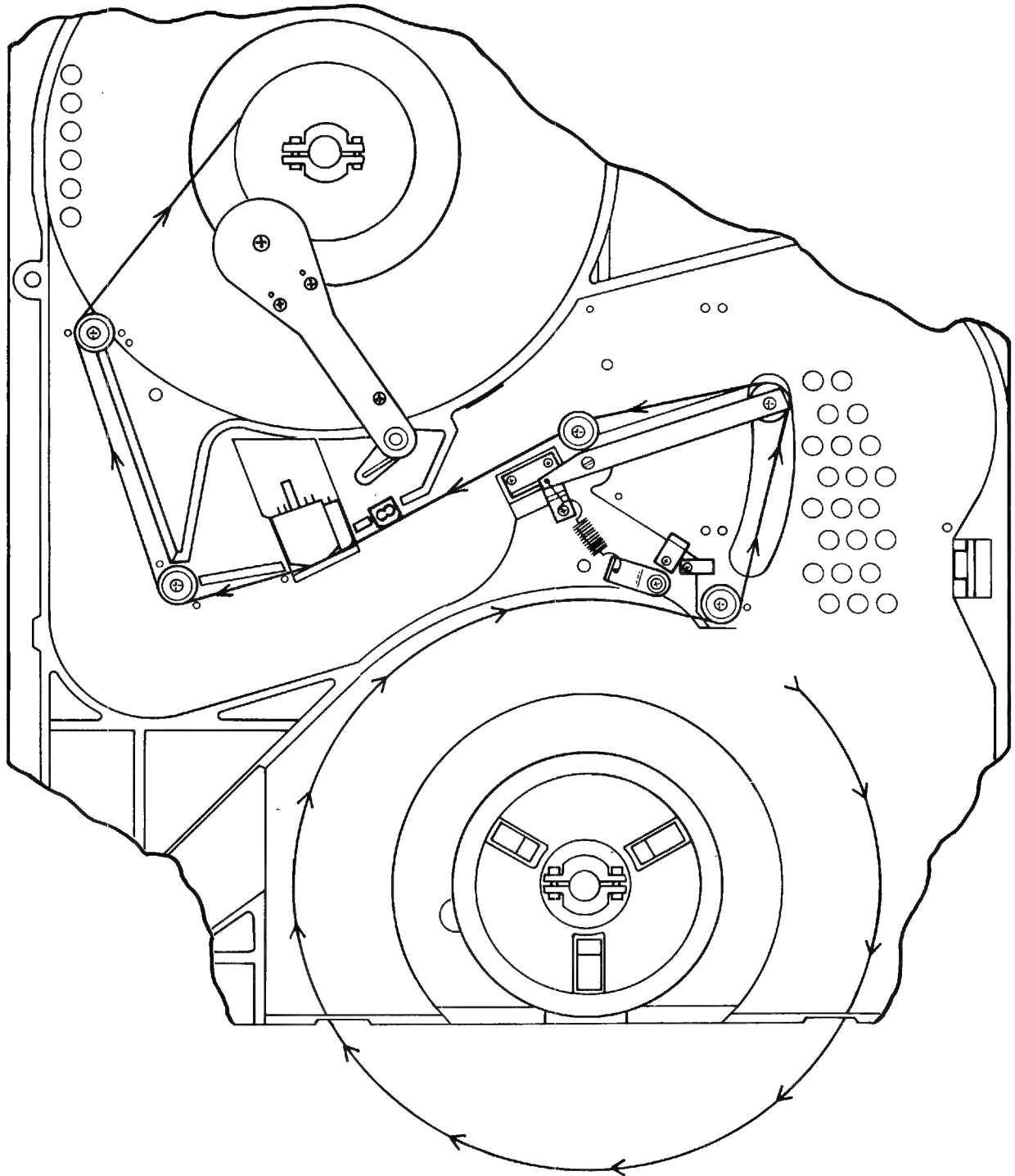


Figure 2-2. Tape Threading Path

SECTION III

TESTING AND TROUBLESHOOTING

TESTING

3-1. This section describes the two types of test capabilities available on the CTU: a series of tests that run automatically when the power is turned on, called power up self tests (PUST), and service aids, accessed by pressing the front panel switches in certain sequences that enable individual sections of the unit for testing and troubleshooting. Also, error conditions that can cause a CTU failure are listed and procedures to diagnose the failure are provided.

3-2. **Power Up Self Tests.** The PUST (Power Up Self Test) consists of a series of tests that are executed each time power is applied to the unit. These tests are designed to verify the proper operation of the unit prior to permitting tape to be loaded or, in the case of a failure, assist the technician in isolating the fault and repairing the unit. If the PUST is successful, the UNLOAD indicator is lighted continuously, and the transport is ready to be loaded. If the PUST is unsuccessful, a unique pattern will be displayed on the front panel LED's to indicate the areas of the failure. This is referred to as level 1 failure information. For certain tests, levels 2, 3, 4, and 5 failure information will be available to provide a more specific cause of the failure.

3-3. The failure display is a binary number which results from the "ON" (1) and "OFF" (0) states of the LED's with the least significant bit being the LOAD indicator on the left and the most significant bit being the HI DEN indicator on the right. See Figure 3-1. For the first six tests, the display will be the number of the test that failed and the drive will be inhibited, preventing any further interaction. Refer to Table 3-1 for PUST failure codes 1 through 6. If after power is applied to the unit, all LED's remain lighted continuously for longer than 1 second, and the LED display does not match the level 1 displays in Table 3-1, a failure of the Z8002 is indicated and no further failure information is available.

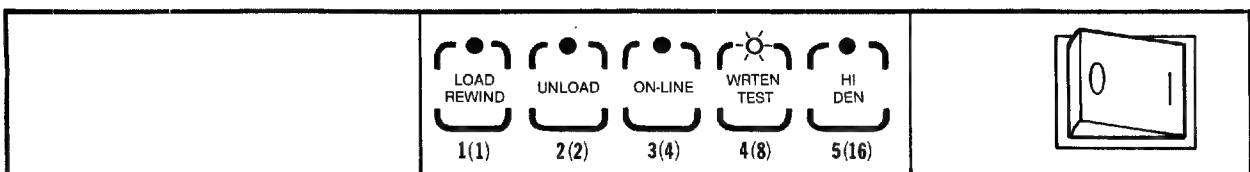


Figure 3-1. Front Panel Controls and Indicators (Diagnostic Mode)

3-4. A failure in test 7 will be indicated by LOAD, UNLOAD, and ON-LINE LED's flashing. Pressing the LOAD switch once will display the level two failure information. Levels 2 through 5 information is presented in two alternating 4-bit nybbles. The high order nybble is displayed when the HI-DEN LED is illuminated. When the HI-DEN indicator is extinguished, the low order nybble is displayed. Table 3-2 includes the levels 2 through 5 information available when the LOAD switch is pressed one through four times respectively.

3-5. A failure in tests 8-13 will be indicated initially by the front panel LED's flashing the failed test number. Referring to Table 3-3 and pressing LOAD a second time will display level two information about the failure, as described in paragraph 3-4.

3-6. When all the failure information is read, pressing the TEST switch will put the unit in the diagnostic mode. The TEST indicator will flash and the service aid access codes can then be entered. The TEST switch can be pressed (to put the unit in the diagnostic mode) any time after all front panel LED's flash. However, all failure information is then lost.

3-7. Use the procedure in Figure 3-2 and the information in Tables 3-1 through 3-3 to recognize and analyze a PUST failure.

3-8. **Service Aids.** The service aids are tests that are enabled by the technician. They are divided into two groups: those that run with no tape in the unit, and those that run after tape has been loaded.

3-9. In the case of a PUST failure of tests 8-13, pressing the TEST switch will put the unit in the diagnostic mode and the service aid codes can then be entered. Note that any failure information not read will be lost. Refer to paragraph 3-6.

3-10. For a normal power-up sequence, once the UNLOAD indicator is lighted continuously, the no-tape service aids can be accessed, or following a load sequence when the LOAD indicator is lighted continuously, the tape-loaded service aid codes can be entered.

3-11. Referring to Figure 3-1, which illustrates the controls of the CTU, the switch sequence for activating each service aid is as follows:

- a. Press switches 4 and 5 in sequence to access the diagnostic mode.
- b. Press switches corresponding to service aid number in sequence.
- c. Execute service aid by pressing switch 5.

NOTE

Each successive switch depression must be entered within 3 seconds, or the diagnostic mode will be aborted and the switch sequence will have to be re-entered.

- d. Press switch 4 to exit the service aid.

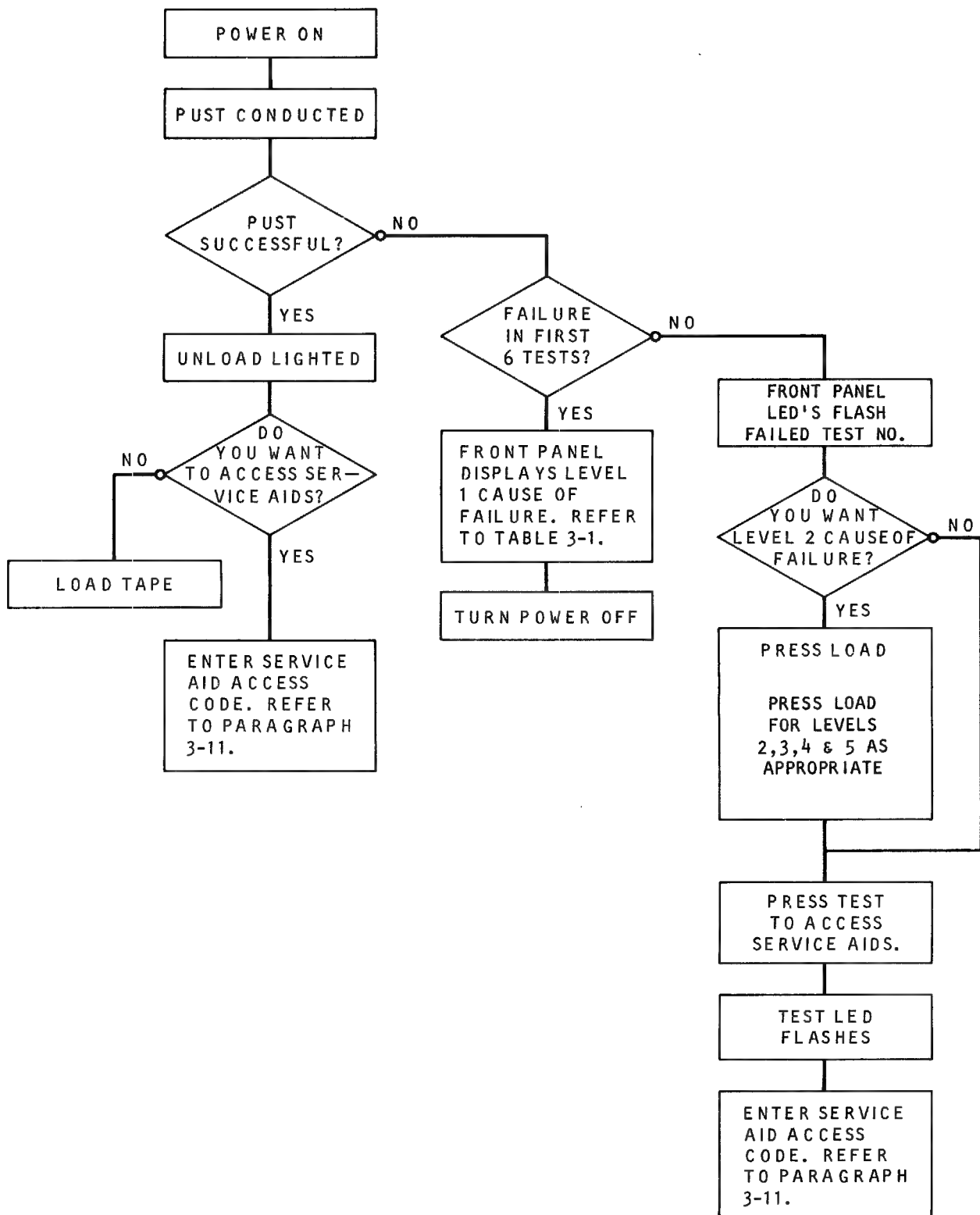


Figure 3-2. Power Up Self Test Process

PUST TEST	FAILURE	LEVEL 1 DISPLAY	LEVEL 2 DISPLAY	REMARKS
1	Low ROM (U5L)	1 0 0 0 0	---	Checksum error
2	High ROM (U3L)	0 1 0 0 0	---	Checksum error
3	Low RAM (U5N)	1 1 0 0 0	---	Data test error
4	High RAM (U3N)	0 0 1 0 0	---	Data test error
5	CIO TEST	1 0 1 0 0	---	Press LOAD
	CIO - Z1		0 0 0 1 0	IC-U9L fails
	CIO - Z2		0 0 0 0 1	IC-U11L fails
	CIO - Z3		0 0 0 1 1	IC-U13L fails
6	Early Test Exit	0 1 1 0 0		Generally indicates a failure in tests 1 thru 5, above. Tests for early PUST exit when TEST pressed and held during power up.

Table 3-1. Tests 1 through 6 PUST Failure Codes

LEVEL 1 DISPLAY	LEVEL 2 LOW HIGH	LEVEL 3 LOW HIGH	LEVEL 4 LOW HIGH	LEVEL 5 LOW HIGH	REASON
11100					DMA/Cache circuits
	10000 00001				DMA failure
		10000 00001 01000 00001 11000 00001 00100 00001 10100 00001			Base address error Word count error No count rollover Addition not 0 No terminal count
	01000 00001				Cache RAM circuits
		10000 00001 01000 00001			Address error (low to high) Address error (high to low)
			10000 00001 01000 00001 00100 00001 00010 00001 00000 10001 00000 01001 00000 00101 00000 00011		RD7 - U10T RD6 - U11R RD5 - U11T RD4 - U9P RD3 - U9R RD2 - U10P RD1 - U11P RD0 - U10R
				10000 00001 01000 00001	Read parity error (U9T) Write parity error (U9T)

Table 3-2. Test 7 PUST Failure Codes

PUST TEST	LEVEL 1 DISPLAY	LEVEL 2 BYTE		REASON
		<u>LOW</u>	<u>HIGH</u>	
8	0 0 0 1 0			CIO initialization failure
9	1 0 0 1 0			DAC/ADC test failed
		1 0 0 0 0	0 0 0 0 1	DAC failed auto-zero
		0 1 0 0 0	0 0 0 0 1	Reference voltage (VIN5) error
10	0 1 0 1 0			Servo motor test failed
		1 0 0 0 0	0 0 0 0 1	Unexpected drive voltage
		0 1 0 0 0	0 0 0 0 1	Unexpected EMF on supply motor
		1 1 0 0 0	0 0 0 0 1	Unexpected EMF on takeup motor
		0 0 1 0 0	0 0 0 0 1	Takeup motor EMF out of tolerance
		1 0 1 0 0	0 0 0 0 1	Takeup motor rotation out of tolerance
11	1 1 0 1 0			Tachometer test failed
		1 0 0 0 0 or 0 1 0 0 0	0 0 0 0 1 0 0 0 0 1	Either of the two phases missing
		1 1 0 0 0	0 0 0 0 1	Both phases missing
		0 0 1 0 0	0 0 0 0 1	Phase separation out of tolerance
12	0 0 1 1 0			EOT/BOT test failed
		1 0 0 0 0	0 0 0 0 1	BOT failed
		0 1 0 0 0	0 0 0 0 1	EOT failed
13	1 0 1 1 0			Compliance arm voltage not in tolerance
		1 0 0 0 0	0 0 0 0 1	Reset voltage too low
		0 1 0 0 0	0 0 0 0 1	Reference voltage (VIN6) error

Table 3-3. Tests 8 through 13 PUST Failure Codes

3-12. As an example, to cycle the supply and takeup servos in the forward and reverse direction, Service Aid 11 should be used with no tape in the unit. To access Service Aid 11 proceed as follows:

- a. Press switches 4 and 5 in sequence.
- b. Press switch 1 two times.
- c. Execute Service Aid 11 by pressing switch 5.

3-13. Each service aid will run continuously, that is repeat its basic sequence, until switch 4 is pressed to exit the service aid. Each service aid description includes any modification of the basic routine that can be enabled while the service aid is running.

3-14. During some service aids, the front panel indicators provide output data relative to the service aid being performed. This data is displayed as a binary number with the LOAD indicator as the least significant bit (LSB) and the HI DEN indicator as the most significant bit (MSB). See Figure 3-1. Each Service Aid description includes information about output data, as appropriate.

3-15. **Service Aids (No tape in unit).** Service aids with no tape in the transport are described in the following subparagraphs. Refer to paragraph 3-14 for a description of the front panel indicators.

CAUTION

If tape is in the unit for the following service aids, it may be damaged.

3-16. **Service Aid 11.** This service aid enables both supply and takeup servo circuits, sequencing both reel hubs clockwise and counterclockwise. Press the LOAD switch to activate the high voltage rail switches Q5 and Q6 and current limit the servos to 1 ampere. Press the UNLOAD switch to deactivate Q5 and Q6 and enable maximum current limit.

3-17. **Service Aid 12.** This service aid activates and deactivates the write formatter circuitry to allow troubleshooting with no tape in the transport. When enabled, the write head/erase bar are turned on and a formatted, 40-character record is generated. The write head/erase bar is turned on for the length of the record (including pre/postamble) plus approximately 15 msec, then the head is turned off for approximately 15 msec and the sequence repeats. The "data" portion of the record simulates an all zeros (3200 fci) record. Press LOAD to select a 1-character record and ONLINE to select a 256-character record. Press UNLOAD for the 40-character record.

3-18. **Service Aid 13.** This service aid operates the same as Service Aid 12 except that the file-mark circuits are exercised.

3-19. **Service Aid 15.** This service aid is used to test the U3T configuration switches. The open/closed state of each switch is displayed on a front panel indicator. When the HI DEN indicator is off, U3T switches 1-4 are displayed on the LOAD, UNLOAD, ONLINE and TEST indicators, respectively. When the HI DEN indicator is on, switches 5-8 are displayed. When a switch is closed, the associated indicator should be on. The front panel indicators are updated continuously so that switches can be changed while the service aid is running. The HI DEN indicator will alternately flash on and off for high order and low order switches, respectively. Refer to Table 1-5.

3-20. **Service Aid 21.** This service aid activates the interface output status signals for troubleshooting. Refer to Figure 3-3 for the relative sequence/timing and test points to observe the signals.

3-21. **Service Aid 22.** This service aid is used to display the output of the BOT sensor. The display is updated continuously so that a piece of half-inch tape with a BOT marker can be inserted in the sensor area (as a loaded tape would be) to determine the output voltage levels for blank tape and a BOT marker. Use Table 3-4 to convert the binary count of the front panel indicators to a decimal equivalent in volts. Ambient light can affect the output levels. With no tape in the sensor area, the binary count should be 14 (about 0.9 volt) or greater. With blank tape the count should be 5 (about 0.3 volt) or less. Some blank tapes may cause the output level to be a negative value which is an acceptable condition (all indicators flashing). For tape with a BOT marker, the count should be 28 (about 1.8 volts) or greater.

3-22. **Service Aid 23.** This service aid is identical to Service Aid 22 except the EOT circuit is activated. Use the same criteria for output voltage levels. There is no requirement that both sensors exhibit the same output characteristics as long as each meets the criteria described for the BOT sensor.

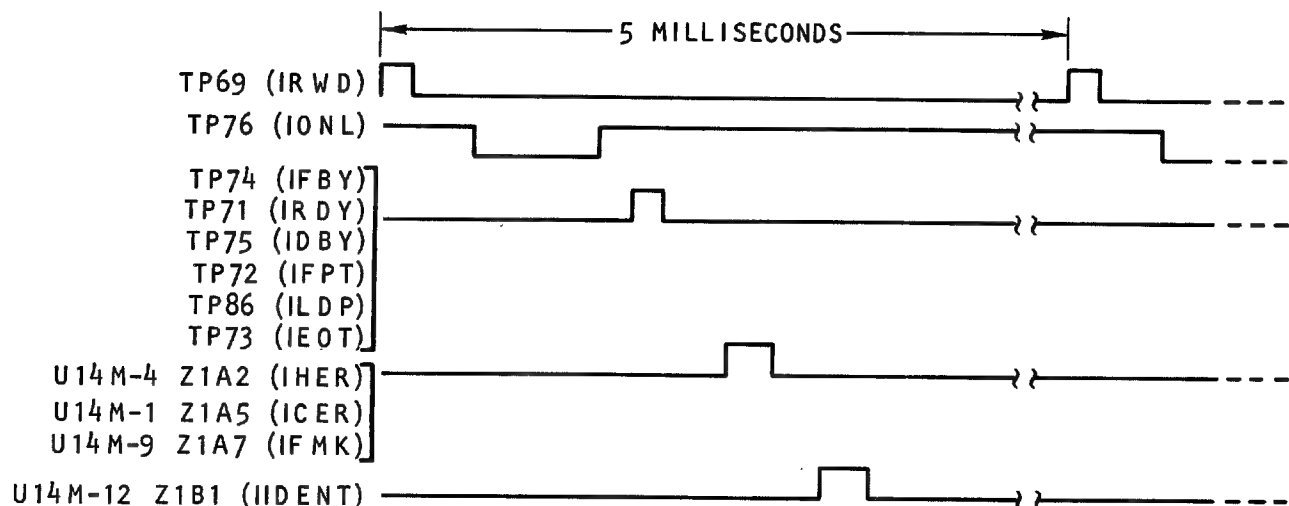


Figure 3-3. Service Aid 21 Sequence/Timing

BINARY DISPLAY	DECIMAL EQUIVALENT	OUTPUT VOLTS	BINARY DISPLAY	DECIMAL EQUIVALENT	OUTPUT VOLTS
0 0 0 0 0	0	0 or less	0 0 0 0 1	16	1.024
1 0 0 0 0	1	0.064	1 0 0 0 1	17	1.088
0 1 0 0 0	2	0.128	0 1 0 0 1	18	1.152
1 1 0 0 0	3	0.192	1 1 0 0 1	19	1.216
0 0 1 0 0	4	0.256	0 0 1 0 1	20	1.280
1 0 1 0 0	5	0.320	1 0 1 0 1	21	1.344
0 1 1 0 0	6	0.384	0 1 1 0 1	22	1.408
1 1 1 0 0	7	0.448	1 1 1 0 1	23	1.472
0 0 0 1 0	8	0.512	0 0 0 1 1	24	1.536
1 0 0 1 0	9	0.576	1 0 0 1 1	25	1.600
0 1 0 1 0	10	0.640	0 1 0 1 1	26	1.664
1 1 0 1 0	11	0.704	1 1 0 1 1	27	1.728
0 0 1 1 0	12	0.768	0 0 1 1 1	28	1.792
1 0 1 1 0	13	0.832	1 0 1 1 1	29	1.856
0 1 1 1 0	14	0.896	0 1 1 1 1	30	1.920
1 1 1 1 0	15	0.960	1 1 1 1 1	31	1.984 or greater

Table 3-4. Service Aids 22/23 Display Conversion (BOT/EOT)

BINARY DISPLAY	DECIMAL EQUIVALENT	VOLTS	BINARY DISPLAY	DECIMAL EQUIVALENT	VOLTS
0 0 0 0 0	0	0 to +0.312	0 0 0 0 1	16	0 to -0.312
1 0 0 0 0	1	+0.313	1 0 0 0 1	17	-0.313
0 1 0 0 0	2	+0.626	0 1 0 0 1	18	-0.626
1 1 0 0 0	3	+0.939	1 1 0 0 1	19	-0.939
0 0 1 0 0	4	+1.252	0 0 1 0 1	20	-1.252
1 0 1 0 0	5	+1.565	1 0 1 0 1	21	-1.565
0 1 1 0 0	6	+1.878	0 1 1 0 1	22	-1.878
1 1 1 0 0	7	+2.191	1 1 1 0 1	23	-2.191
0 0 0 1 0	8	+2.504	0 0 0 1 1	24	-2.505
1 0 0 1 0	9	+2.817	1 0 0 1 1	25	-2.817
0 1 0 1 0	10	+3.130	0 1 0 1 1	26	-3.130
1 1 0 1 0	11	+3.443	1 1 0 1 1	27	-3.443
0 0 1 1 0	12	+3.756	0 0 1 1 1	28	-3.756
1 0 1 1 0	13	+4.069	1 0 1 1 1	29	-4.069
1 1 1 1 0	15	+4.069 or greater	1 1 1 1 1	31	-4.069 or less

Table 3-5. Service Aid 24 Display Conversion (Compliance Arm)

3-23. **Service Aid 24.** This service aid is used to display the compliance arm transducer voltages on the front panel. When this service aid is initially activated, the front panel will display the actual maximum and minimum transducer voltages when the arm is at its rest position (against rear bumper) and its fully forward position, respectively. This initial voltage is displayed as a binary value on the front panel indicators. This is the mode 1 or actual arm voltage. Refer to Table 3-5 to convert the binary count to a decimal equivalent in volts. The display is continuously updated so that as the arm is moved, the binary value will change relative to the new position; e.g., when the service aid is activated and the compliance arm is in the rest position, the front panel may display a binary count of 5 (+1.565 volts). If the arm is moved slowly toward the front bumper, the count will be observed to decrement to 0, switch to 16 (this is the sign bit, indicating a negative voltage value), and then increment to perhaps 21 (-1.565 volts). These maximum/minimum readings are the absolute limits of the arm. To determine the total voltage change (V-Delta) of the arm, place the arm in its rest position and press UNLOAD (mode 2). The front panel display will indicate a zero volt reference value at this time. Flickering of the HI DEN indicator is an acceptable condition in this position. As the arm is moved to its fully forward position, the binary count will increment to perhaps a value of 10 (+3.13 volts, from Table 3-5). The minimum value of voltage change for proper operation within the compliance arm travel limits is 2.191 volts (binary 7). To return to the mode 1 voltage condition, press the LOAD switch. Unlike this example, the voltage readings could be entirely in the positive or negative voltage region. Press TEST to exit this service aid.

3-24. **Service Aid 31.** This service aid is used to check the file-protect/reel-seat sensor and tape-in-path sensor. Only the supply servo is enabled. To check the file-protect/reel-seat sensor, remove the write-enable ring from a tape reel and place the reel on the supply hub. As the hub rotates counterclockwise, a double pulse of the UNLOAD indicator should occur when the reel-seat tab passes the sensor. With a write-enable ring installed, an additional single pulse of the UNLOAD indicator should occur when the file-protect tab rotates past the sensor. For tape-in-path testing, the LOAD indicator should be illuminated initially, indicating no tape-in-path. Insert a piece of half-inch tape so that it blocks the tape-in-path sensor and extinguishes the LOAD indicator. During this service aid, the LOAD switch controls the supply motor. Each time the LOAD switch is pressed the motor will decrease its speed. Repeated actuation of the LOAD switch will cause the motor to stop and then increase speed in the opposite direction. Without a tape reel mounted on the supply hub, no flashing indication of the UNLOAD indicator should occur.

3-25. **Service Aid 32.** This service aid activates the hub-lock and door-lock assemblies. The supply motor alternates direction to operate the supply reel locking pawls. In the counterclockwise direction, the pawls should retract (unlocked position) when the hub tab engages the bellcrank. In the clockwise direction, the pawls should extend (locked position) when the hub tab engages the bellcrank. If either the top cover or front panel door is open, the ONLINE indicator illuminates.

CAUTION

This service aid is intended for use only by a
service technician during troubleshooting.

3-26. **Service Aid 33.** This service aid disables both top cover and front panel door interlocks to allow observation of the tape path during operation of tape-loaded service aids. It may be accessed either before or after an auto- or manual load sequence. This service aid is not terminated with the TEST switch and will remain enabled until the tape is unloaded or the power is turned off.

3-27. **Service Aid 34.** During this service aid, the LOAD switch controls the blower motor. When the LOAD indicator is illuminated, the blower motor should be on.

3-28. **Service Aid 41.** Identification of the EPROM firmware at PWB locations U3L and U5L is possible by executing this service aid and observing the front panel LED's. If LOAD is pressed and the TEST indicator is ON, high performance 125 ips firmware is installed; if the TEST indicator is OFF, 75 ips firmware is installed. If UNLOAD is pressed, HI DEN ON indicates 1600/3200 BPI density. HI DEN OFF indicates 1600 BPI density. Pressing ON-LINE will generate a sequenced front panel display with a binary value flashed to the indicators at a 1.2 second interval. Each binary value represents a digit in the Cipher part number of the low order EPROM in location U5L. A "0" in the part number is represented by the HI DEN LED being lit. A dash is indicated by all LED's being lit. There are 10 steps in the process, including the dash number. The sequence may be recycled by pressing ON-LINE again if the observer has difficulty reading the Cipher part number the first time through the sequence. Press TEST to exit this service aid.

3-29. **Service Aid 42.** This service aid activates the cache memory DMA controller (channel 2), address and data lines for troubleshooting. See Figure 3-4 for the relative timing/sequence of a cache memory write operation. The data lines have a high state (1) value rotated through the byte from LSB to MSB, therefore, only one bit is high at a time. The address lines have a low state (0) value rotated through the 16 bit address word, thus, only one address line is low at a time. Pressing TEST exits the service aid.

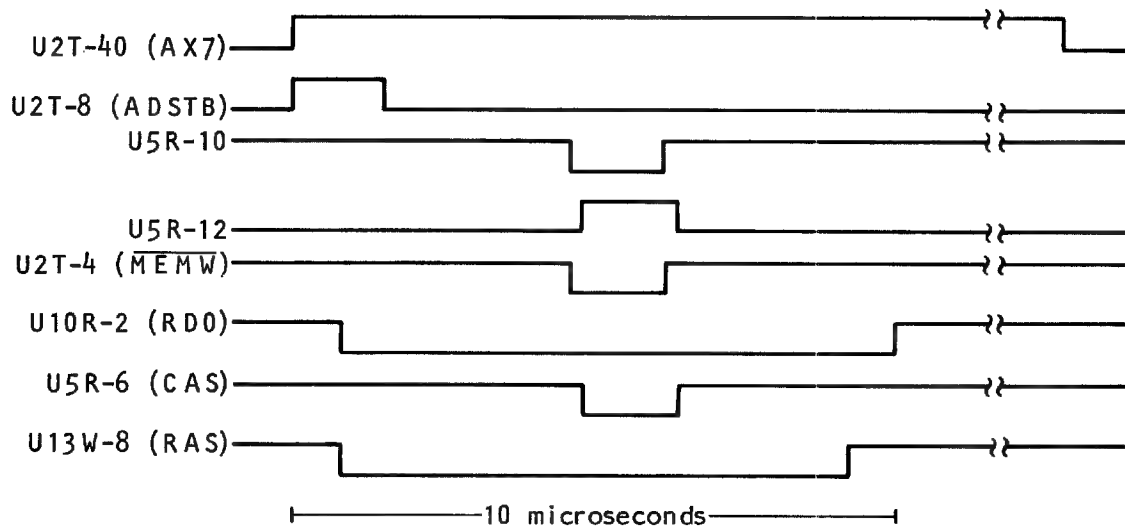


Figure 3-4. Service Aid 42 Sequence Timing

3-30. **Service Aids (Tape Loaded).** Service aids with tape in the unit are described in the following subparagraphs.

NOTE

The tape loaded service aids cannot be initiated if the tape-in-path sensor is faulty. Refer to paragraph 3-24 for detection of a faulty tape-in-path sensor.

3-31. **Service Aid 21.** This service aid is intended for adjustment of the read threshold and is usually required only when changing the head assembly or the main PWB. A good quality tape, with the write enable ring installed, should be loaded prior to entering this service aid. While observing the front panel indicators, adjust R109 until three (3) or more LED's are flashing and no LED's are ON constantly. Refer to paragraph 4-17 for detailed adjustment procedure and cautionary notes.

3-32. **Service Aid 22.** This service aid cycles the tape in both forward and reverse directions simulating the tape motion requirements of interface commands. The formatting and data circuits are not active during this service aid. Tape travel in the forward direction is always greater, and, when the tape reaches the EOT marker, the unit will rewind and repeat the sequence. When the service aid is exited, the tape will rewind if not at BOT.

3-33. **Service Aid 23.** This service aid activates the read circuits and the write circuits using the sequence described for Service Aid 12. Press LOAD, UNLOAD, or ONLINE to select 1-byte, 40-byte, or 32K-byte records respectively. Selecting the block size initiates forward tape motion. An approximate 8 second delay will occur before forward tape motion is observed. This delay is required to sequentially load and verify all 0's into each of the nine 64K-byte cache RAMs prior to tape motion. Press HI DEN to stop tape motion. Press HI DEN a second time for reverse tape motion. The HI DEN indicator illuminates to indicate reverse tape motion. Reverse motion inhibits the write function and read only is active. If the tape used is file protected, previously recorded data can be read in both forward and reverse directions. The EOT marker inhibits forward tape motion and BOT inhibits reverse. The 3200 CPI CTU will operate in the high density mode during this service aid (50 ips) when high density is selected (HI DEN indicator illuminated) before the service aid is entered. When the service aid is exited, the tape can be rewound to BOT by pressing LOAD/REWIND.

TRANSPORT ERROR CONDITIONS

3-34. Error conditions, other than those that would be indicated during the PUST, may occur while operating the CTU. Those normally caused by the tape or operator (Operator Error Codes) are discussed in Section II, paragraph 2-7. The Transport Error Codes are machine malfunctions which indicate a serious deviation from the normal operating routine of the CTU. Each error code is represented by a unique binary pattern on the front panel indicators which flash a quick double-pulse to alert the operator. These faults inhibit the CTU and require correction by a service technician. They can be cleared only by turning the power off.

3-35. Refer to Table 3-6 for an explanation of the error conditions and some actions to take to correct the problem (1 designates a double-flashing indicator; 0 designates off). Some errors indicated during operation may, in turn, cause a PUST failure. In that case the troubleshooting steps must begin with the PUST failure.

3-36. Table 3-7 contains a listing of mnemonics used in the Operation and Maintenance manual, together with their respective definitions.

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
3	1 1 0 0 0	The CTU detected more than 3700 feet of tape beyond the BOT marker.	1. Try a different tape reel.
4	0 0 1 0 0	Compliance arm circuit voltage levels out of tolerance during the auto-load sequence.	1. Check that tape is properly wrapped around takeup hub. 2. Check compliance arm operation with Service Aid 24.
6	0 1 1 0 0	The CTU received a write or erase command for a file protected tape.	1. Possible host system failure. 2. Check that write-enable ring is removed from tape reel. 3. Check file-protect circuit with Service Aid 31. 4. Check interface logic with Service Aid 21.
7	1 1 1 0 0	An illegal or undefined command was received by the CTU.	1. Possible host system failure. 2. Check interface logic for floating or grounded inputs.
8	0 0 0 1 0	Internal status self-check fault.	1. Note host command sequence: operating system program, version, release, etc. 2. Contact factory.
10	0 1 0 1 0	Write Edit failure.	1. New block size greater than original. 2. Re-check block size.
11	1 1 0 1 0	The number of write retries exceeded 16.	1. Try a different tape. 2. Check the write circuits using Service Aid 12 (no tape in unit) or 23 (tape loaded). 3. Check the read circuits using Service Aid 23 (tape loaded).

Table 3-6. Transport Error Codes

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
12	0 0 1 1 0	No end of block on read after write check.	<ol style="list-style-type: none"> 1. Check write circuits with tests 12 and 13. 2. Check write and read circuits with test 23.
13	1 0 1 1 0	Internal status self-check fault.	<ol style="list-style-type: none"> 1. Note host command sequence: operating system program, version, release, etc. 2. Contact factory.
14	0 1 1 1 0	Tape travel beyond the EOT marker exceeded 18 feet.	<ol style="list-style-type: none"> 1. Possible host system failure. 2. Check interface logic with Service Aid 21. 3. Check EOT/BOT circuit with Service 32. 4. Check that tape has EOT marker properly placed.
15	1 1 1 1 0	Data block exceeded maximum block size allowed (32K).	<ol style="list-style-type: none"> 1. Possible host system failure (write operation). 2. Check ILWD interface input logic for a floating condition.
17	1 0 0 0 1	The compliance arm exceeded its travel limits during normal operation.	<ol style="list-style-type: none"> 1. If unit missed EOT or BOT and tape ran off reel, check EOT/BOT circuit with Service Aid 32. 2. Check compliance arm operation with Service Aid 24. 3. Check servo operation with Service Aid 11.
18	0 1 0 0 1	Tape speed variation in excess of the ANSI maximum of $\pm 10\%$.	<ol style="list-style-type: none"> 1. Check servo operation with Service Aid 11. 2. Check tachometer operation using Service Aid 11.

Table 3-6. Transport Error Codes (Continued)

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
19	1 1 0 0 1	Vertical parity error on retries.	1. Check write and read circuits using Service Aid 23 (tape loaded).
20	0 0 1 0 1	DMA failure. Word count not at 0 after timeout.	1. Verify that PUST test 7 is successfully completed. 2. Check DMA and cache address/data lines using Service Aid 42.
21	1 0 1 0 1	Excessive retries on write filemarks.	1. Readjust read threshold using Service Aid 21 with tape loaded. 2. Check write formatter circuits using Service Aid 13 with tape unloaded, not file protected and writing 40-character blocks (press UNLOAD after test entry).
24		Parity error during cache RAM refresh cycle.	1. Check for "soft" RAM fault: cycle power to force power-up check. 2. Check cache RAM with PUST test 7. Rerun host program.

Table 3-6. Transport Error Codes (continued)

<u>TERM</u>	<u>IN/OUT</u>	<u>NAME</u>	<u>DEFINITION</u>
ZI - A0	I	IFEN	Formatter enable (not used)
A1	I	IGOT	Formatter command pulse detected
A2	0	IHER	Hard error
A3	0	ICER	Correctable error
A4	I	MERR	Memory parity error
A5	0	FWD/ $\overline{\text{REV}}$	Formatter control
A6	I	PERR	Parity error
A7	0	IFMK	EOF detected
ZI - B0	N/C		
B1	0	IDENT	ID burst at BOT
B2	0	IOENAB	Enable I/P at interface
B3	0	$\overline{\text{FMTRD}}$	Enable read transfer from formatter
B4	0	FIOCLK	Formatter interface clock
B5	I	$\overline{\text{POSTERR}}$	Postamble error
B6	I	$\overline{\text{VRCERR}}$	Vertical parity error
B7	I	$\overline{\text{POSTDET}}$	Postamble detect
ZI - C0	0	$\overline{\text{W2XCLK}}$	Write logic 2X clock
C1	0	FRC2	Write state control 2
C2	0	FRC3	Write state control 3
C3	0	ENB 40 CNT	Enable 40 state counts (for FMK, Pre/Postamble)

Table 3-7. I/O Definitions (CIO)

<u>TERM</u>	<u>IN/OUT</u>	<u>NAME</u>	<u>DEFINITION</u>
Z2 - A0	I	$\overline{\text{RDROP 7}}$	Read after write channel drop detected
A1	I	$\overline{\text{RDROP 6}}$	"
A2	I	$\overline{\text{RDROP 5}}$	"
A3	I	$\overline{\text{RDROP 4}}$	"
A4	I	$\overline{\text{RDROP 3}}$	"
A5	I	$\overline{\text{RDROP 2}}$	"
A6	I	$\overline{\text{RDROP 1}}$	"
A7	I	$\overline{\text{RDROP 0}}$	"
Z2 - B0		$\overline{\text{RDROP P}}$	Read after write channel drop detected
B1	I	DOPEN	Door open (lid or front)
B2	I	HLOCK	Hub lock
B3	O	DLOCK	Door lock
B4	O	BLK	Block detect (read data)
B5	I	PHASE 2	Tach (pos'n interrupt)
B6	I	TIP	Tape in path
B7	O	MENAB	Motor enable (relay drive)
Z2 - C0	O	$\overline{\text{REFRESH}}$	Refresh DMA request
C1	O	$\overline{\text{PEN}}$	PE enable (read formatter)
C2	O	$\overline{\text{BLOWER}}$	Blower on
C3	N/C		

Table 3-7. I/O Definitions (CIO) (Cont'd)

<u>TERM</u>	<u>IN/OUT</u>	<u>NAME</u>	<u>DEFINITION</u>
Z3 - A0	I/O	UNLOAD	Front panel
A1	I/O	LOAD	
A2	I/O	ON-LINE	
A3	I/O	TEST	
A4	I/O	$\overline{\text{HIDEN}}$	
A5	0	M30	
A6	0	P30	
A7	0	$\overline{\text{MTREN}}$	
Z3 - B0	0	$\overline{\text{WHD}}$	Write head current
B1	I	TACH PULSE 0	Tach count enable
B2	I	$\overline{\text{EHD}}$	
B3	I	0I	
B4	0	HDEN	
B5	I	TACH PULSE 1	
B6	I	FPTTAB	
B7	I	PHASE 1	
Z3 - C0	0	DADR0	ADDRESS 0, D/A - A/D Converter
C1	0	DADR1	ADDRESS 1, D/A - A/D Converter
C2	0	DADR2	ADDRESS 2, D/A - A/D Converter
C3	0	$\overline{\text{DADREN}}$	D/A sample hold enable

Table 3-7. I/O Definitions (CIO) (Cont'd)

PULSE N	(Sht. 2, U6W)
0 -	D0 IFBYFORMATTER BUSY D1 IRDYTAPE DRIVE READY D2 IDBYDATA BUSY D3 IFPTFILE PROTECT D4 ILDPLOAD POINT (@ BOT) D5 IEOTEND OF TAPE
1 -	..... SET ON-LINE
2 -	..... CLEAR REWINDING
3 -	..... SET REWINDING
4 -	..... CLEAR OFF-LINE
5 -	
6 -	..... IGO TRANSITION LATCH CLEAR
7 -	..... CLEAR DMA REQ. FOR FORMATTER
	..... READ, SET FOR WRITE

Table 3-7. I/O Definitions (CIO) (Cont'd)

SECTION IV

MAINTENANCE

GENERAL

4-1. This section contains periodic maintenance information and adjustment procedures. Table 4-1 presents the preventive maintenance schedule.

CTU POSITIONS FOR SERVICING

CAUTION

When CTU is to be extended on slides from equipment rack, ensure that rack is mounted securely. Weight of CTU in extended position could upset an inadequately anchored equipment rack.

4-2. **Operator Maintenance Access (See Figure 4-1).** To gain access to the tape path area for routine cleaning, proceed as follows:

- a. Switch CTU power off.
- b. Withdraw drive on its slides until locks engage.
- c. Open top cover by lifting sides directly behind front panel. Place cover stay in slot provided.
- d. Perform required maintenance.
- e. To return drive to operating position, close top cover.
- f. Release slide locks and push unit back into equipment rack.
- g. Switch MSTU power on.

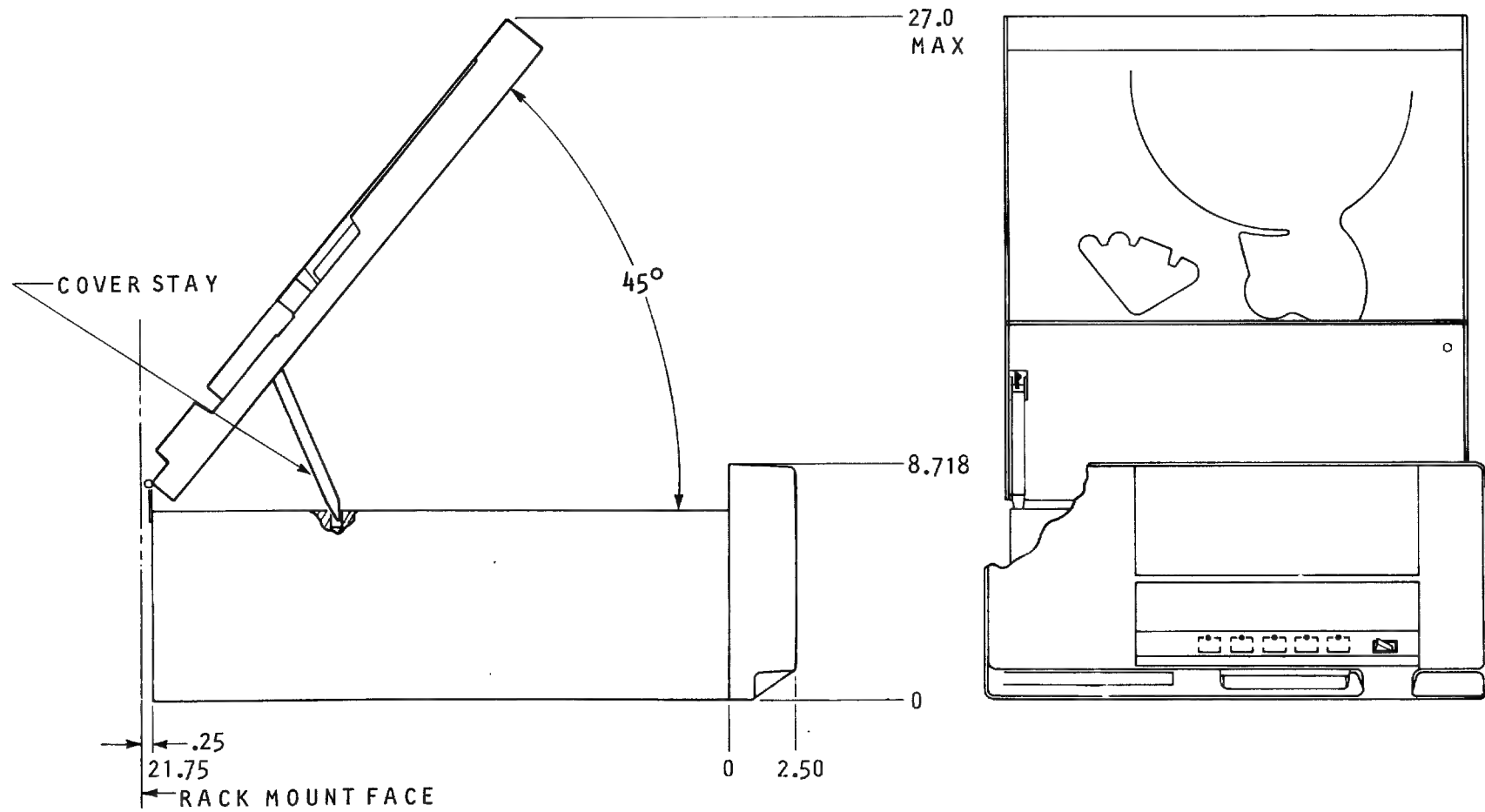


Figure 4-1. Operator Maintenance Access Position

4-3. **Service Access (See Figure 4-2).** To gain access to the main PWB and other internal components, proceed as follows:

- a. Switch CTU power off.
- b. Place drive in operator maintenance access position. (Refer to paragraph 4-2.)
- c. Using a screwdriver, loosen two captive screws located at front sides of top plate casting.
- d. Close top cover.
- e. Grasping two lower corners of front panel, lift front panel to its maximum upright position. Lower slowly (about one inch) until the top plate support latch engages.
- f. Insert the safety pin provided through both holes in the top plate support.
- g. Perform required maintenance.
- h. To return drive to operating position, remove the safety pin.
- i. Lift front panel to its maximum upright position and lower smoothly to horizontal position.
- j. Reverse steps a through d.

OPERATOR PREVENTIVE MAINTENANCE

4-4. For routine cleaning, place the CTU in the operator maintenance access position. Figure 4-3 identifies by number the locations of items that require routine cleaning. The recommended cleaning materials are:

- a. Lint-free cloths
- b. Solvent resistant swabs
- c. Tape drive cleaner (liquid)

NOTE

Items a through c are available as Cipher Part No. 960855-001, Tape Drive Cleaning Kit.

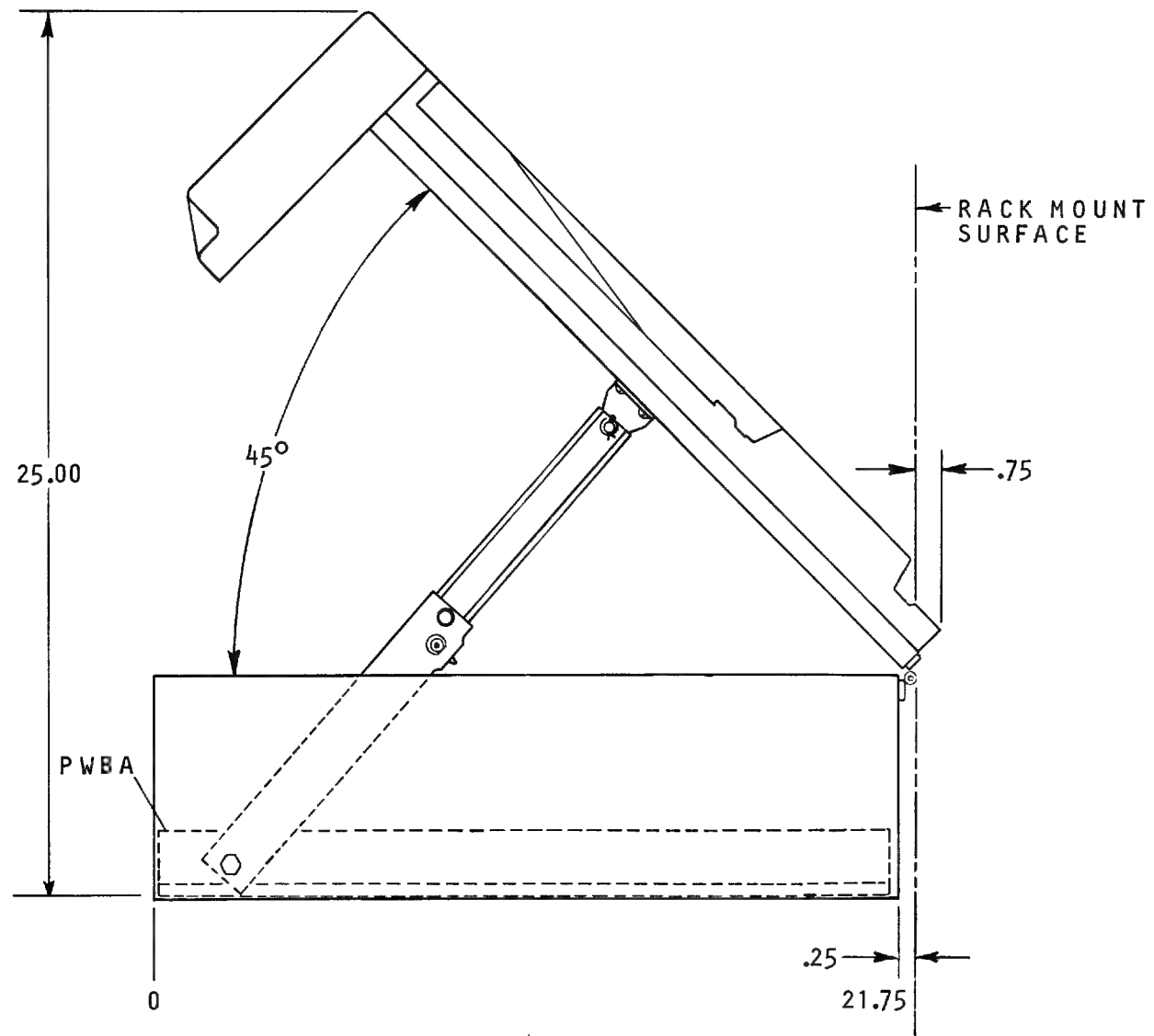


Figure 4-2. Service Access Position

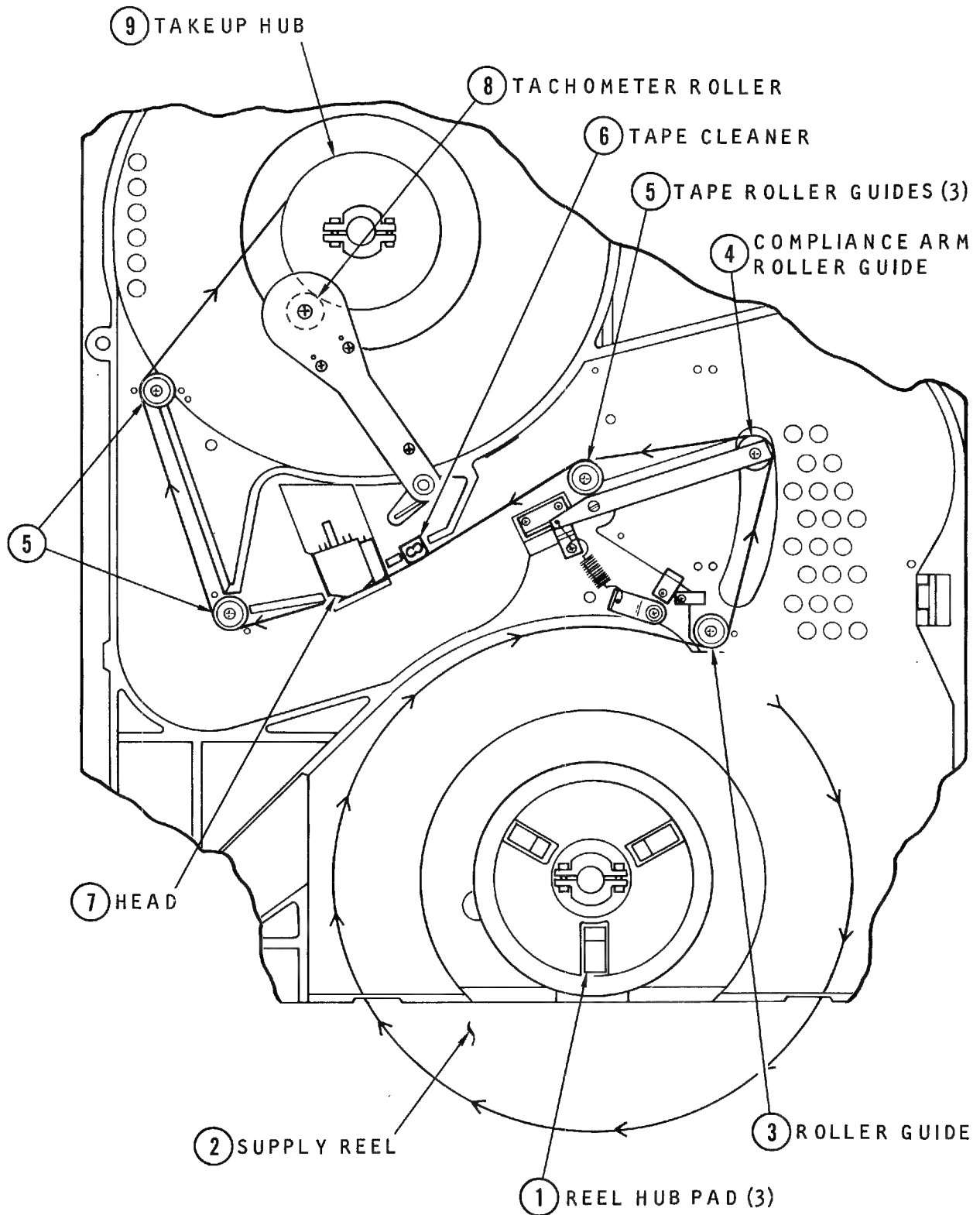


Figure 4-3. Tape Path and Related Parts

MAINTENANCE OPERATION	FREQUENCY (HOURS)	QUANTITY TO MAINTAIN	PROCEDURE PARAGRAPH
Operator			
Tachometer Roller	8	1	4-5
Take Up Hub	8	1	4-6
Roller Guides	8	5	4-7
Reel Hub Pads	8	3	4-8
Head	8	1	4-9
Tape Cleaner	8	1	4-10
Front Panel and Door	As Required	1	4-11
Top Plate Casting	As Required	1	4-12
Filter	1000	1	4-13
Service Technician			
Replace Reel Motors	5000	2	4-40 4-44

Table 4-1. Preventive Maintenance Schedule

CAUTION

Do not apply a cleaner directly from the container to the surface to be cleaned, even though instructions on the container may indicate to do so. Always apply the cleaner to a swab or wipe first, carefully removing any excess. The tachometer roller and roller guides contain precision bearings. Solvents allowed to run into the bearings will break down the lubricant.

4-5. **Tachometer Roller (8, Figure 4-3).** Use a swab moistened with tape path cleaner. Gently wipe the entire roller surface. The roller can be rotated by manually turning the take-up hub slowly.

4-6. **Take-Up Hub (9, Figure 4-3).** Use a swab or wipe moistened with tape path cleaner. Rotate the hub manually while gently wiping the tape wrapping surface.

4-7. **Roller Guides (3, 4 and 5, Figure 4-3).** Use a swab moistened with tape path cleaner. Rotate each roller and gently wipe the tape contact surface and flanges or washers.

4-8. **Reel Hub Pads (1, Figure 4-3).** Use a swab or wipe moistened with tape path cleaner. Wipe the contact surface of each pad and remove any debris around the pad.

4-9. **Head (7, Figure 4-3).** Use a swab or wipe moistened with head cleaner. Wipe the entire face of the head and attached erase bar, paying particular attention to the recessed areas.

CAUTION

Rough or abrasive materials can scratch sensitive surfaces of the head resulting in permanent damage. Other cleaners, such as alcohol based types, can cause read/write errors.

4-10. **Tape Cleaner (6, Figure 4-3).** Use a swab moistened with head cleaner. Wipe each blade along its length. Remove accumulated oxides from the recessed area between the blades.

CAUTION

Exercise care to avoid damage to sharp edges of tape cleaner blades.

4-11. **Front Panel and Door.** Use a wipe moistened with plastic cleaner.

4-12. **Top Plate Casting.** Use a wipe moistened with plastic cleaner. Referring to Figure 4-3, wipe away the oxide dust in the tape path area. Be careful not to get dirt on the head, rollers, etc. Avoid disturbing the sensors.

4-13. **Filter.** Locate and remove the filter from inside the air duct opening at the lower left of the front panel. See Figure 4-4. Clean the filter with low pressure compressed air, or vacuum, in the opposite direction of airflow and reinstall.

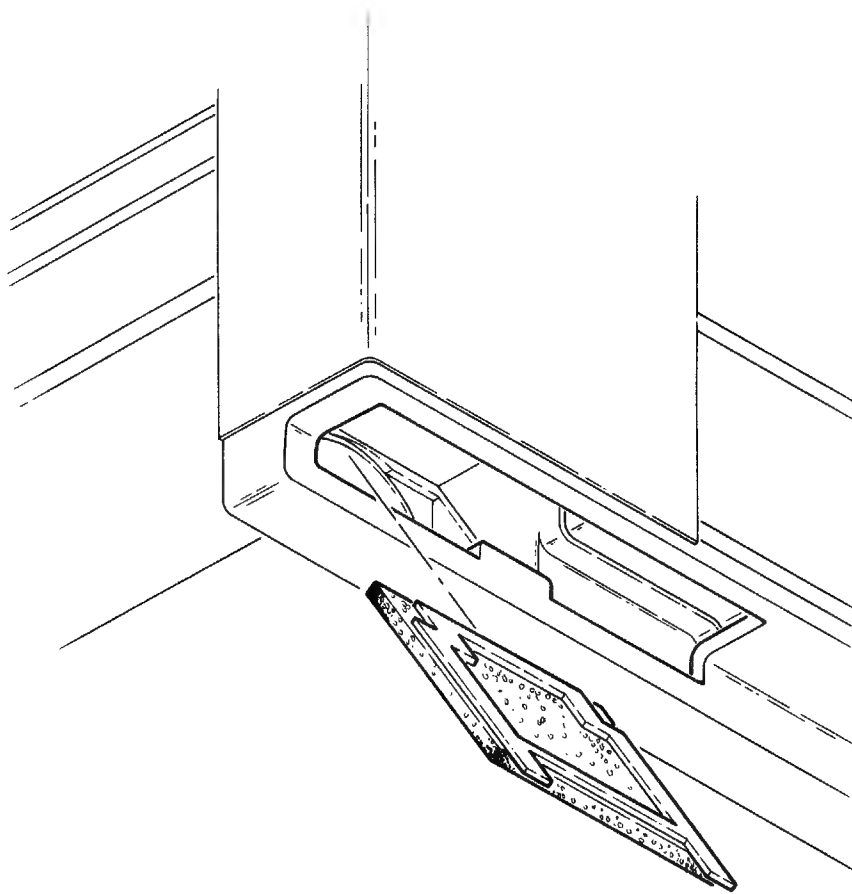


Figure 4-4. Air Filter Removal

SERVICE TECHNICIAN PREVENTIVE MAINTENANCE

4-14. **Reel Motors.** Replace both reel motors after 5000 hours of unit operation. Refer to paragraphs 4-40 and 4-44 for removal/replacement instructions.

CORRECTIVE MAINTENANCE

4-15. **Fuse Removal and Replacement.** To replace the fuse, proceed as follows:

WARNING

To prevent severe electrical shock, remove power plug from power source before performing any servicing operation on transport.

- a. Remove power cord from outlet.
- b. Place the drive in service access position. Refer to paragraph 4-3.
- c. Locate fuse cap on power supply housing. Push and twist cap to remove.
- d. For 100-120 volt operation, use a 3-ampere, slo-blo, 250V type fuse.
- e. For 208-240 volt operation, use a 1-1/2 ampere, slo-blo, 250V type fuse.
- f. Reverse steps a through c.

4-16. **Voltage Regulator Adjustment.** A minor adjustment of the +5V voltage regulator circuit may be required following repair of the power supply or main PWB's or replacement of a major assembly on the unit. To adjust the +5V regulator circuit, proceed as follows:

- a. Place the drive in service access position. Refer to paragraph 4-3.
- b. Switch power on and allow unit to warm-up.
- c. Connect a voltmeter to TP81 and ground.
- d. Adjust R312 for +5.25, $\pm 0.05V$.
- e. Reverse steps a through c.

4-17. **Read Threshold Adjustment.** Adjustment of the read threshold level is required only when the head or main PWB is changed. Adjust read threshold as follows:

- a. Place drive in service access position. Refer to paragraph 4-3.
- b. Apply power to unit.
- c. Load tape (write-enable ring must be installed).

NOTE

Use a National Bureau of Standards Reference Level Tape, or a certified tape that produces comparable read levels when compared with a National Bureau of Standards tape for this adjustment.

CAUTION

Do not use a library or removed tape for this adjustment because the tape used will be written on by the CTU.

- d. Activate Service Aid 21. Refer to paragraphs 3-8 and 3-20.
- e. Shield the LED indicators on the front panel from ambient light so that an accurate indication of ON, OFF or FLASHING can be observed.
- f. Note the indication of the front panel LED's before attempting any adjustment.
- g. If any three or more indicators are FLASHING with no indicator(s) ON steadily, NO ADJUSTMENT IS REQUIRED. Refer to step i.
- h. If less than three indicators are FLASHING or any indicator(s) are ON steadily, adjust R109 for the indication in step g. R109 may require several turns (in either direction) to find the correct adjustment point. If the correct adjustment point cannot be found, a fault in (a) effecting the adjustment, (b) the head assembly, or (c) main PWB is indicated.
- i. Exit Service Aid 21 by pressing TEST.

NOTE

This adjustment is based on the amplitude characteristics of the tape used for the adjustment. Other tapes whose amplitude characteristics are different may not provide the same indication after the adjustment. This fact simply reflects the difference in tapes and is not a fault condition. The tolerance range of the adjustment takes into account the inherent differences between tapes that otherwise meet the ANSI X 3.40-1976 criteria.

- j. Reverse steps a through c.

REPAIR AND REPLACEMENT OF PARTS AND COMPONENTS

4-18. The CTU is designed to operate over long periods of time without requiring corrective maintenance of any kind. Spare parts are available for replacement of parts and subassemblies which may have become damaged or worn through extremely long and/or hard usage. This section presents instructions for removal of defective parts and subassemblies from the transport and replacement with the parts available, as well as disassembly, assembly, and adjustment instructions where applicable.

Except as noted, subassemblies and parts which can be removed from above the top plate are indexed in Figure 4-5, while those which can be removed from beneath the top plate are indexed in Figure 4-6. Refer to the respective key lists of these figures for the names of the subassemblies and parts indexed on each. These lists also contain the figure numbers of the detail drawings, presented in this section, in which removal and/or disassembly of these subassemblies and parts are illustrated.

WARNING

To prevent severe electrical shock, remove power plug from power source before performing any servicing operation on transport.

ITEM	DESCRIPTION	CIPHER P/N
1	Hub height adjustment tool	760105-545
2	Skew monitor (IC clip assy.)	960067-001
3	Spring scale (for tension arm) 0-36 oz spring scale John Chatillon & Sons 83-30 Kew Gardens Rd. Kew Gardens, NY 11415	Chatillon P/N LP36
4	Tape end cutter/crimper	209990-500
5	Vibratight (for adjustment screws)	209990-075
6	Torque seal (for screw heads)	209994-025
7	Loctite -222- adhesive	209990-072
8	Loctite 242	209990-074
9	Loctite -601- fast retaining compound	209990-076
10	Permabond - sealer (air duct)	209990-107
11	Lubriplate - bearing lubricant	210444
12	Master Skew tape (IBM)	799019-401
13	Tracking tape Pericom Corp. 14 Huron Dr. Natick, MA 01760 (617) 237-4052	970039-001

Table 4-2. Repair and Maintenance Tool/Parts List

FRONT PANEL ASSEMBLY (I, Figure 4-5).

4-19. Power Switch Replacement. To replace the power switch (I, Figure 4-7), proceed as follows:

- a. Remove power cord from outlet.
- b. Position transport in service access position in accordance with instructions in paragraph 4-3.
- c. Remove wire connectors from terminals of power switch in back of front panel, identifying each terminal as to the switch terminal from which it was removed.
- d. Bend in tabs holding switch to panel, and push out of panel from back.
- e. Place replacement switch in front panel, bend tabs in back of switch as necessary to fit tightly in panel, and reconnect wires as identified in step c.
- f. Restore transport to operating position.

FIGURE & INDEX NO.	DESCRIPTION	DETAIL FIGURE NO.	PROCEDURE PARAGRAPH NO.
4-5	MODEL CTU TAPE TRANSPORT (Top View).....	REF	
-1	FRONT PANEL ASSEMBLY	4-7	4-21
-2	SUPPLY HUB ASSEMBLY	4-8	4-23
-3	HEAD ASSEMBLY.....	4-10	4-24
-4	ROLLER GUIDE ASSEMBLY.....	4-11	4-25
-5	EOT/BOT SENSOR ASSEMBLY.....	4-12	4-26
-6	TACHOMETER ASSEMBLY.....	4-13	4-27
-7	COVER ASSEMBLY	4-14	4-28
-8	TAKEUP HUB ASSEMBLY.....	4-15	4-29
-9	COMPLIANCE ARM ASSEMBLY	4-17	4-30
-10	TAPE-IN-PATH SENSOR, TRANSMITTER	4-18	4-32
-11	TAPE-IN-PATH SENSOR, RECEIVER	4-19	4-33
-12	COMPLIANCE ARM BUMPER ASSEMBLY.....	4-20	4-34
-13	ROLLER TAPE GUIDE ASSEMBLY (Solid)	4-21	4-35
-14	FILE-PROTECT SENSOR.....	4-22	4-36

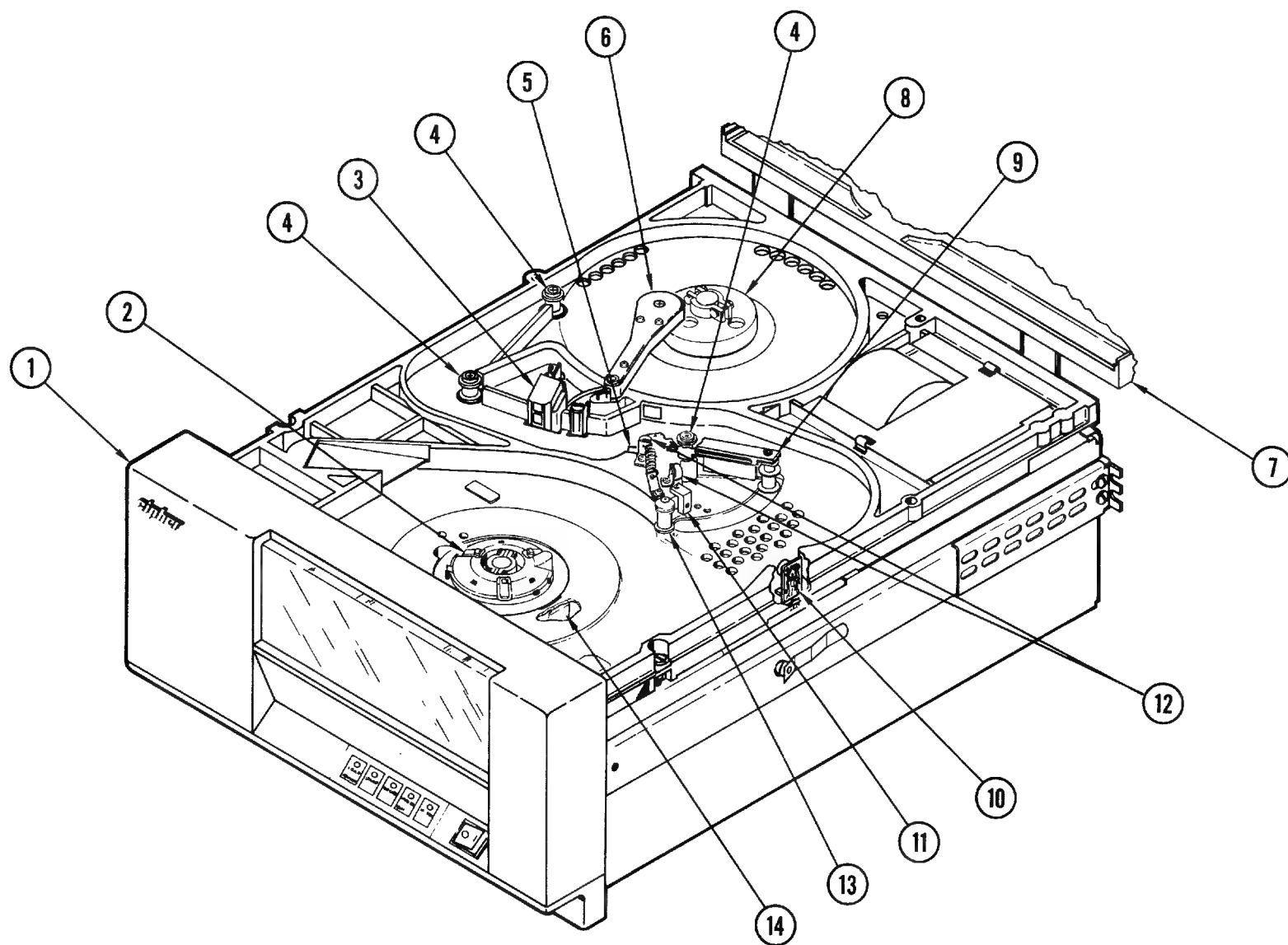


Figure 4-5. Model CTU Tape Transport (Top View)

FIGURE & INDEX NO.	DESCRIPTION	DETAIL FIGURE NO.	PROCEDURE PARAGRAPH NO.
4-6	MODEL CTU TAPE TRANSPORT (Bottom View) .	REF	
-1	DRIVE MAIN PWB ASSEMBLY	4-23	4-37
-2	POWER SUPPLY ASSEMBLY	4-24	4-38
-3	POWER SUPPLY PWB	4-25	4-39
-4	TAKEUP MOTOR ASSEMBLY.....	4-26	4-40
-5	AIR DUCT, top-plate	4-27	4-41
-6	AIR DUCT, front panel	4-27	4-42
-7	TUBE, air intake	4-27	4-41
-8	SUPPLY MOTOR ASSEMBLY	4-28	4-44
-9	AIR CAPACITOR ASSEMBLY.....	4-17	4-30
-10	HUB LOCK ASSEMBLY	4-29	4-45
-11	DOOR LOCK ASSEMBLY	4-30	4-48
-12	TRANSFORMER ASSEMBLY	4-31	4-49

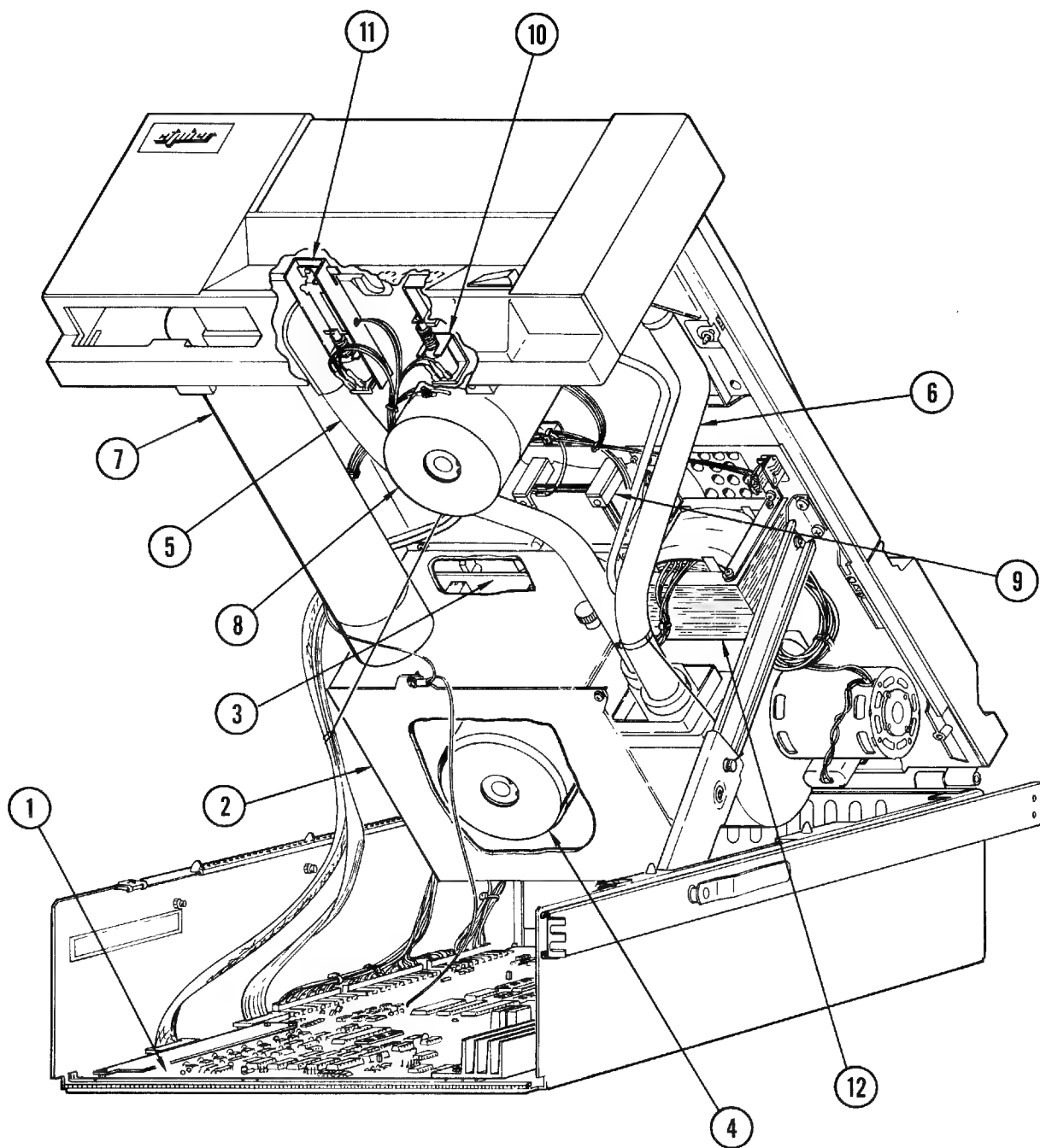


Figure 4-6. Model CTU Tape Transport (Bottom View)

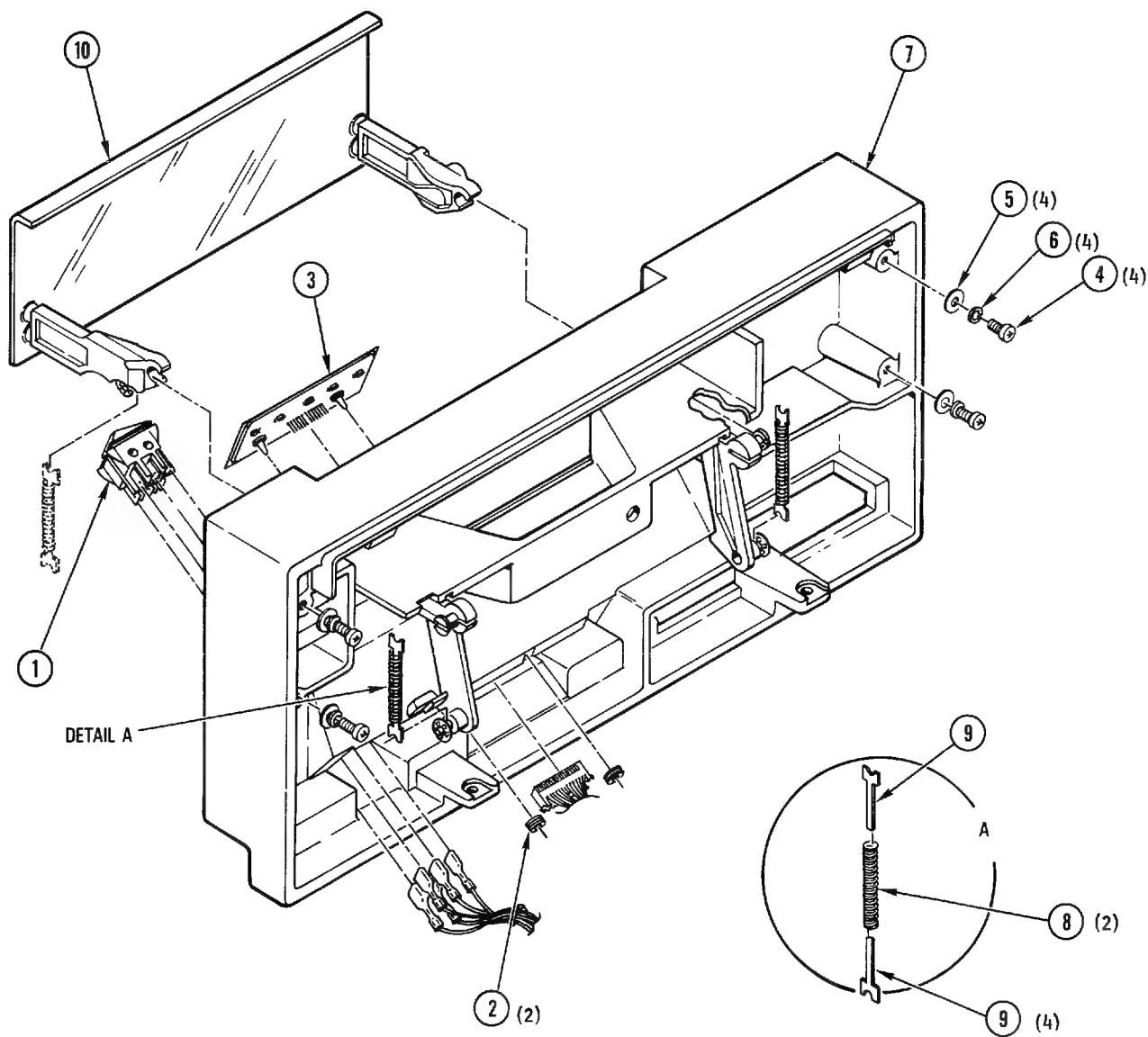


Figure 4-7. Front Panel Assembly

4-20. Touch Switch Replacement. To replace the touch switch (3, Figure 4-7), proceed as follows:

- a. Position transport in service access position (paragraph 4-3).
- b. Remove connector from switch in back of front panel, noting position of connector.
- c. Remove grommets (2) from attachment posts of switch (3) and lift switch out of front panel.
- d. Insert replacement switch in front panel, place grommets (2) on attachment posts, pressing down tightly against panel, and secure using Permabond.
- e. Attach switch connector at back in same position as removed in step b (brown wire nearest power switch).
- f. Restore transport to operating position.

4-21. Front Panel Subassembly Replacement. To replace the front-panel subassembly (7, Figure 4-7), proceed as follows:

NOTE

For purposes of this procedure, it is assumed that power switch (1), touch switch (3), and door assembly (10) are to be removed from discarded front panel subassembly and reused in replacement. If one or more of these items is also to be replaced, disregard instructions for removal of such items in this paragraph.

- a. Position transport in service access position (paragraph 4-3).
- b. Open front-panel door (10).
- c. Remove four screws (4), lockwashers (5), and flat washers (6). Remove switch wire terminals and connectors attached to switches (1 and 3), noting position of each. Lift off entire front panel assembly.

NOTE

If air intake tube comes off with front panel, remove from front panel and set aside for reassembly.

- d. Remove following parts and subassemblies from discarded front-panel subassembly (7) and replace in replacement front panel subassembly as follows:
 - (1) Power switch: refer to paragraph 4-19.
 - (2) Touch switch: refer to paragraph 4-20.
 - (3) Door assembly: refer to paragraph 4-22.
- e. If air intake tube came off with front panel replace in front panel.
- f. Attach complete front panel assembly to top plate with screws, washers, and lockwashers removed in step c. Ensure that gooseneck of front panel air duct is properly positioned (paragraph 4-42, step f).
- g. Reconnect wires and connectors as identified in step c.
- h. Restore transport to operating position.
- i. Use Service Aid 32 to test door lock adjustment. Refer to paragraph 4-48, step j for adjustment procedure.

4-22. Removal And Replacement of Door Assembly. To replace the door assembly (10, Figure 4-7), proceed as follows:

- a. Remove front panel assembly from top plate in accordance with paragraph 4-21, steps a, b, and c.
- b. Remove two springs (8) and four guides (9), and push door out of front panel, using finger pressure on back of door from under side of panel.
- c. Install door assembly in front panel subassembly by snapping arms onto plastic studs of front panel assembly, as indicated in Figure 4-7.
- d. Assemble guides (9) with springs (8), with flat surfaces of guides in contact with each other.
- e. Reinstall assembled front panel assembly on top plate in accordance with paragraph 4-21, steps e-i.
- f. Use Service Aid 32 to test door lock adjustment. Refer to paragraph 4-48, step j for adjustment procedure.

SUPPLY HUB ASSEMBLY (2, Figure 4-5).

4-23. **Removal, Replacement and Adjustment (Figure 4-8).** Place transport in operator maintenance access position (paragraph 4-2) and proceed as follows:

- a. Rotate hub assembly (1, Figure 4-8) so that socket-head screws face front panel door.
- b. Open front-panel door and loosen socket-head screws (2).
- c. Remove supply hub from reel motor shaft.
- d. Install replacement hub on shaft, and position hub height gauge, Cipher Part No. 760105-545, as shown in Figure 4-9 so that it contacts the raised machined surface of the top plate. Raise the supply hub until the reference surface contacts the hub-height tool.
- e. Ensuring that hub-height tool is in contact with both the top plate and reel hub, tighten socket-head screws (2).
- f. Remove tool, restore transport to operating position, and load tape.
- g. Run tape forward and reverse using Service Aid 23, noting tape position on reel for which replacement hub was installed. If tape is centered between sides of reel, adjustment is correct. If not, loosen socket-head screws and repeat steps d through g until positioning is correct.

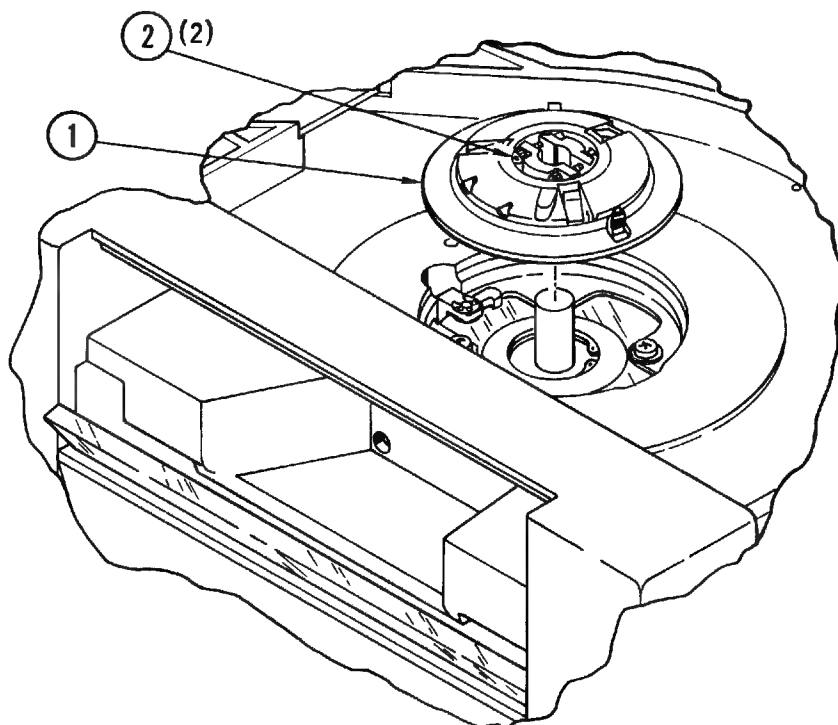


Figure 4-8. Supply Hub Assembly

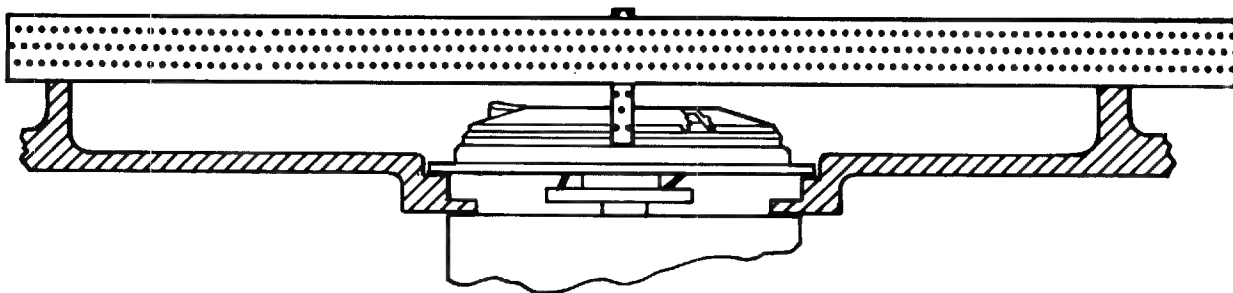


Figure 4-9. Supply Hub Adjustment

HEAD ASSEMBLY (3, Figure 4-5).

4-24. **Removal and Replacement of Assembly and Parts (Figure 4-10).** Place the transport in service access position (paragraph 4-3) and proceed as follows:

NOTE

It is not necessary to remove complete assembly from top plate in order to remove tape scraper (14, Figure 4-10). Refer to this paragraph, step f. If head is defective and in need of replacement, entire head assembly (9), including tape scraper (14) must be replaced.

- a. Remove head connectors from P6/P7 on main PWB and remove from cable retractor.
- b. Working from under side of top plate, remove center adjustment screw (1), lockwasher (2), flat washer (3), four screws (4), and lockwashers (5), three flat washers (6), one flat washer (7), and cable clamp (8) supporting assembly (9) with one hand as last screw is removed. Identify wire terminal and cable clamp as to position from which removed, and save attaching parts for reinstallation.
- c. Pull assembly (9) and wire harness carefully down through hole in top plate and cables over air intake tube.
- d. Install replacement assembly in reverse order of sequence in steps b and c, carefully pushing head and connectors through hole in top plate and attaching wire terminal and cable clamp in positions from which removed. Do not tighten center adjustment screw (1) at this time.
- e. Feed head connectors and cables through cable retractor and over air intake tube and install on J6/J7 on main PWB.

- f. If tape scraper (14) only is to be replaced, remove two socket-head screws (13), nuts (10), lockwashers (11), and flat washers (12). Save attaching parts for reassembly, and install replacement scraper in reverse order of removal.
- g. Adjust tape scraper (14) as follows:
 - (1) Insert and load a tape.
 - (2) Loosen socket-head screws (13) and move tape scraper away from tape.
 - (3) Slowly move tape scraper toward tape until it contacts tape.
 - (4) Rotate tape scraper until both scraper blades are touching the tape, producing two vertical creases in the tape at the points of contact.
 - (5) Verify that tape is touching erase bar. Check for vertical crease in tape at the point of contact.
 - (6) Tighten socket-head screws (13) and reverify that tape is in contact with both blades of tape scraper and the erase bar.
- h. Perform tape alignment procedure, paragraph 4-50.
- i. Place transport in operating position.

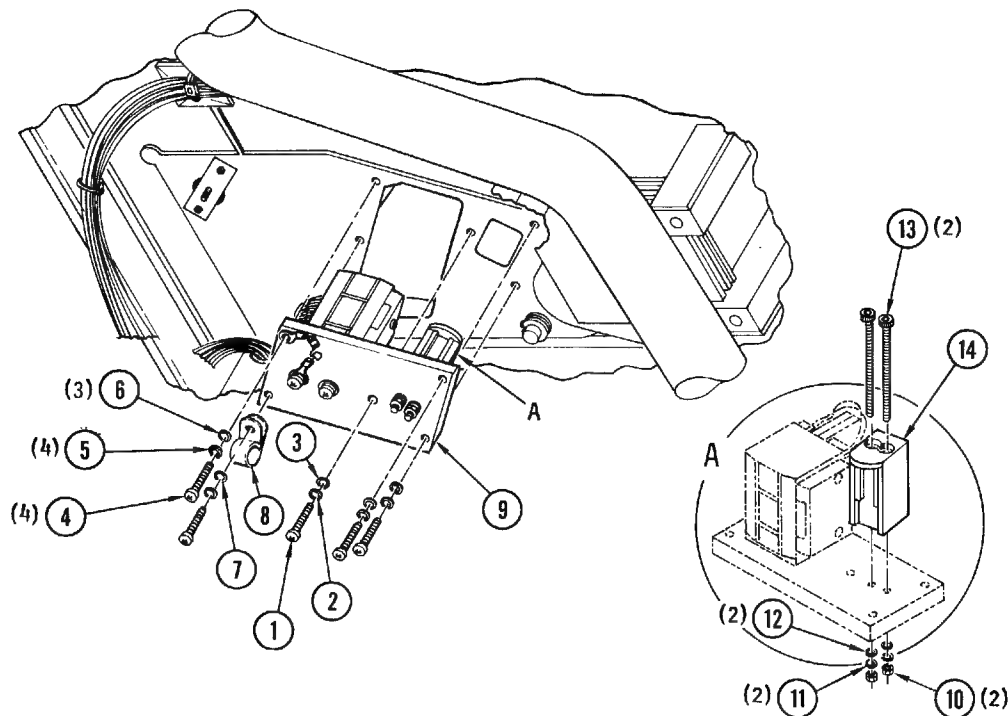


Figure 4-10. Head Assembly

ROLLER GUIDE ASSEMBLY (4, Figure 4-5).

4-25. **Removal and Replacement of Assembly (Figure 4-11).** Place the transport in operator maintenance access position (paragraph 4-2) and proceed as follows:

- a. Remove attaching screw (1, Figure 4-11), leaving shims (4) and spring (3) in place, remove roller guide assembly through top of top plate, saving attaching parts for reassembly.
- b. Install replacement roller guide (2), using original attaching parts.
- c. Perform tape alignment procedure, paragraph 4-50.

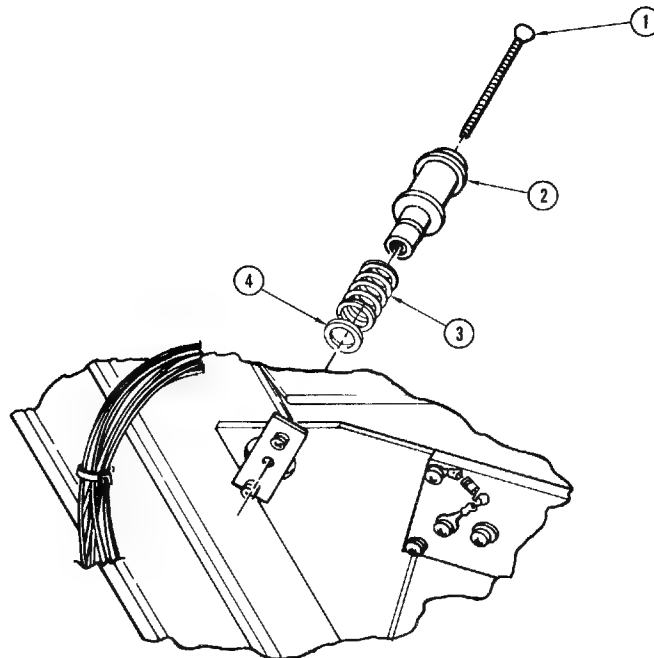


Figure 4-11. Roller Guide Assembly

EOT/BOT SENSOR ASSEMBLY (5, Figure 4-5).

4-26. **Removal and Replacement (Figure 4-12).** Place transport in operator maintenance access position (paragraph 4-2) and proceed as follows:

- a. Holding compliance arm aside to provide access to mounting screws, remove two screws (1, Figure 4-12) and lock washers (2) and retain for reassembly.
- b. Remove EOT/BOT assembly (3), carefully pulling wires and connector (4) through hole in top plate assembly.

- c. Unplug EOT/BOT assembly.

CAUTION

To prevent misalignment, avoid contact with sensors mounted on replacement EOT/BOT PWB. Sensors are factory-aligned for optimum output.

- d. Attach plug removed in step c.
- e. Feed wires and connector (4) carefully through hole in top plate assembly (refer to step b).
- f. Attach EOT/BOT assembly loosely with screws (1) and lockwashers (2), position assembly as close to tape as mounting bracket will allow, with PWB parallel to casting wall directly behind it, and tighten screws.
- g. Place transport in operating position.
- h. Use Service Aids 22 and 23 to test EOT/BOT assembly.

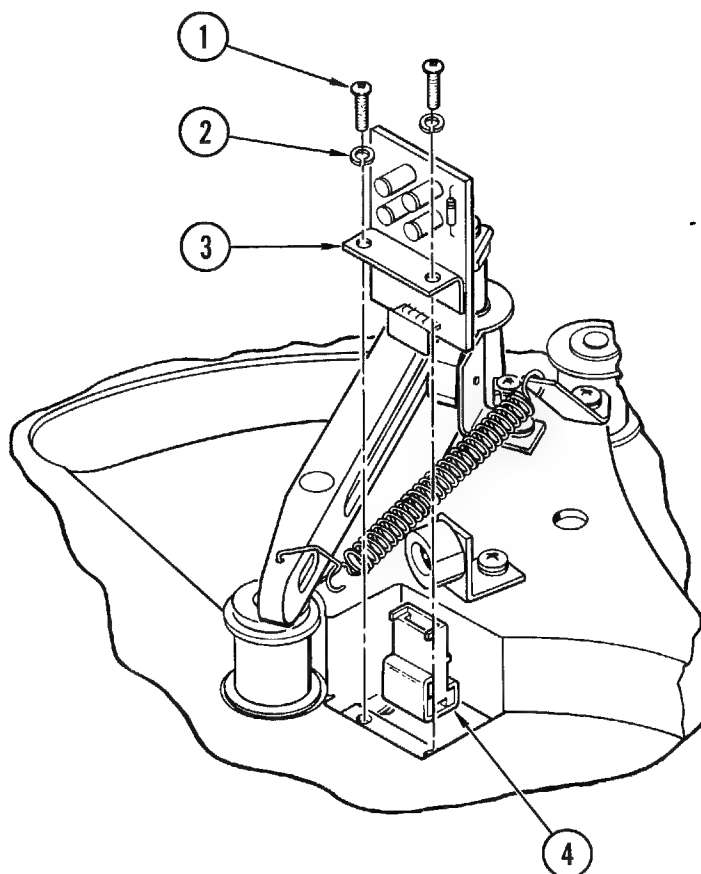


Figure 4-12. EOT/BOT Assembly

TACHOMETER ASSEMBLY (6, Figure 4-5).

4-27. Removal and Replacement (Figure 4-13). Place the transport in service access position (paragraph 4-3) and proceed as follows:

- a. Disconnect tachometer wiring harness connector from mating connector beneath top plate.
- b. Remove grip ring (1, Figure 4-13), wavespring washer (2), and shim(s) (3) from tachometer post beneath top plate and save for reassembly.
- c. Remove tachometer assembly (6) from top plate, pulling wire harness and connector carefully through hole.
- d. If lower bearing (4) or upper bearing (5) was removed, apply Loctite 601 sparingly to outside surface of replacement bearing before installing.
- e. Install replacement tachometer assembly through upper bearing (5) and lower bearing (4), seating end of spring in adjacent small hole in top plate.
- f. Install shim(s) (3), wavespring washer (2), and grip ring (1). If necessary, install additional shims (3) to compress wavespring half of its height when grip ring is installed.
- g. Push connector and wire harness through top plate hole, and connect beneath top plate.
- h. Place transport in operating position.
- i. Use Service Aid 11 to test tachometer operation.

COVER ASSEMBLY (7, Figure 4-5).

4-28. Removal and Replacement of Assembly and/or Parts (Figure 4-14). Place the transport in operator maintenance access position (paragraph 4-2). Remove damaged cover assembly, subassemblies, and/or parts as necessary in the sequence of index numbers (Figure 4-14) assigned to the item and its attaching parts, saving attaching parts for use during reassembly if necessary, and install the replacement item in reverse sequence of removal. Observe the following special instructions:

- a. When replacing catch (10) tighten screws just enough to hold and then try closing cover. If catch is too far forward and prevents cover from closing or is too far back to engage latch on front panel assembly, loosen attaching screws (7) and move catch forward or backward so that the cover closes and catch latches securely on front panel.
- b. Restore transport to operating position.

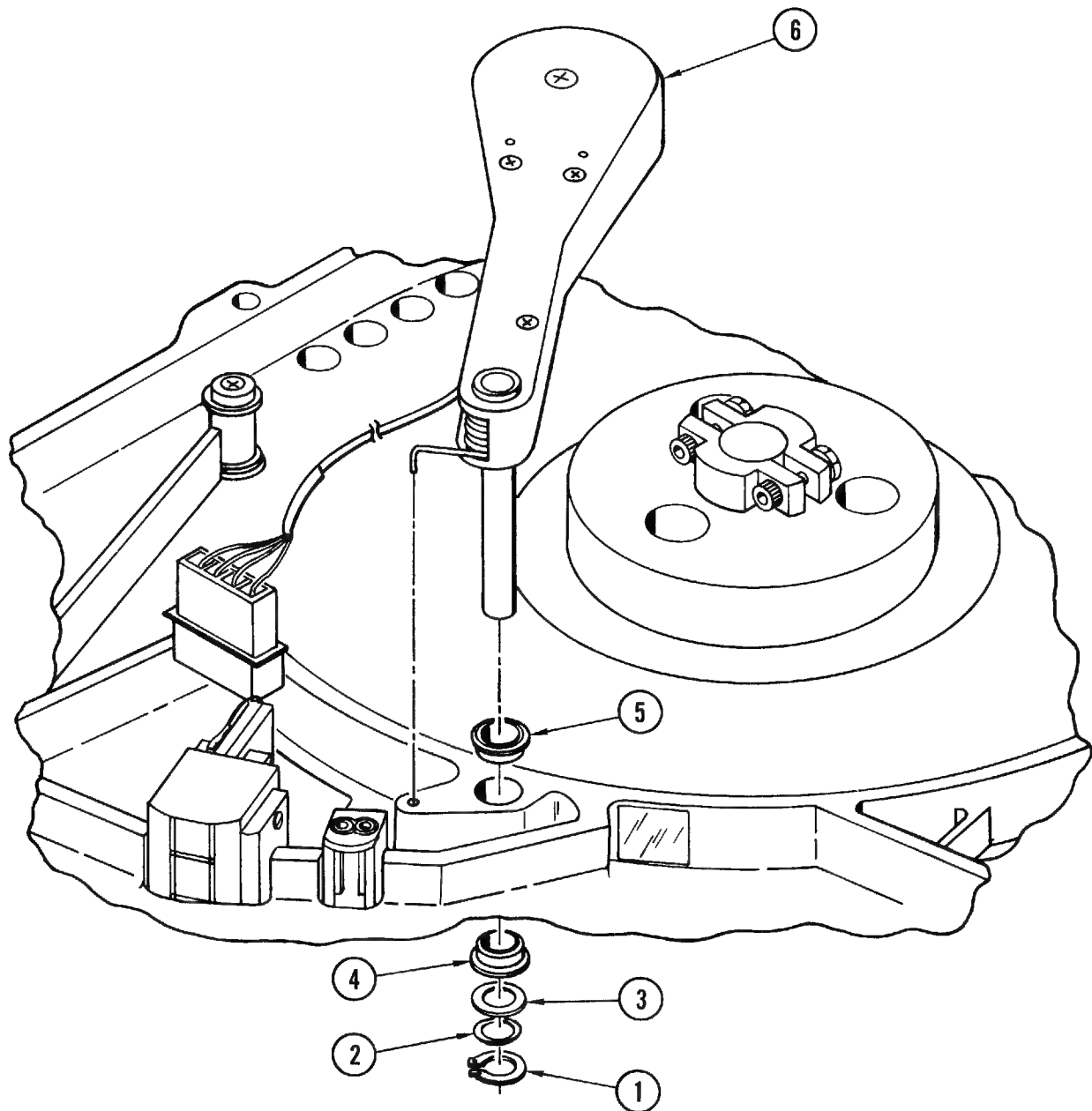


Figure 4-13. Tachometer Assembly

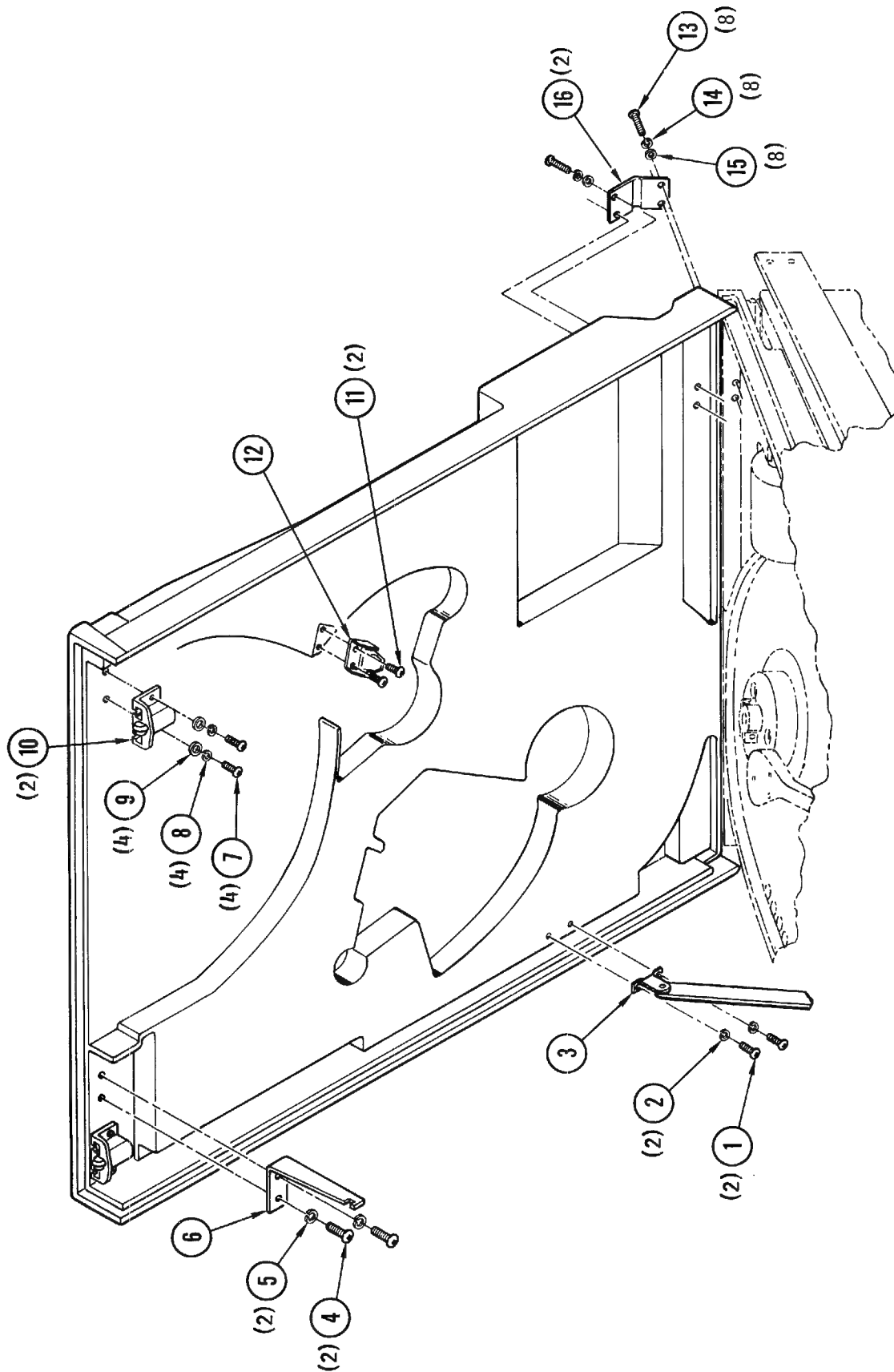


Figure 4-14. Top Cover Assembly

TAKEUP HUB ASSEMBLY (8, Figure 4-5).

4-29. **Removal, Replacement, and Adjustment (Figure 4-15).** Place the transport in operator maintenance access position (paragraph 4-2) and proceed as follows:

- a. Secure tachometer assembly (1) away from the takeup hub.
- b. Loosen socket-head screws (2, Figure 4-15) and remove hub (3).
- c. Install replacement hub on shaft and position hub height gauge, Cipher part No. 760105-545, as shown in Figure 4-16.
- d. Position hub on shaft so that hub height gauge is in contact with both the raised machined area of the top plate and takeup hub, and tighten socket-head screws (2).
- e. Remove tool, carefully replace tachometer assembly against hub, restore transport to operating position, and load tape.
- f. Run tape forward and reverse using Service Aid 23, noting tape position on replacement hub. If tape is centered on hub, adjustment is correct. If not, loosen socket-head screws (2) and repeat steps b through e.
- g. Place transport in operating position.

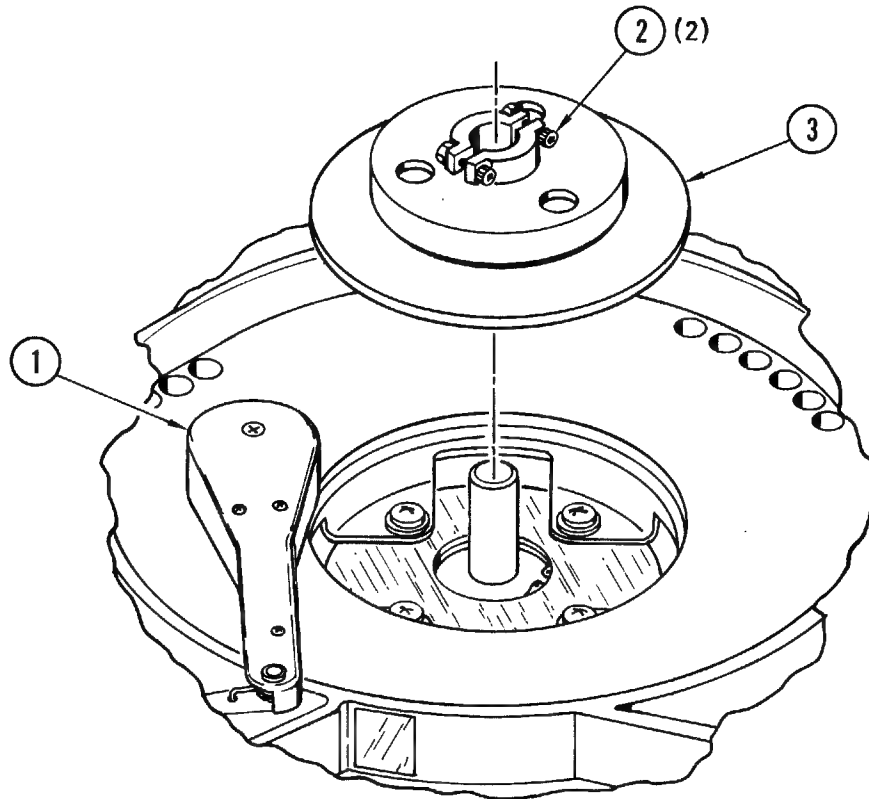


Figure 4-15. Takeup Hub

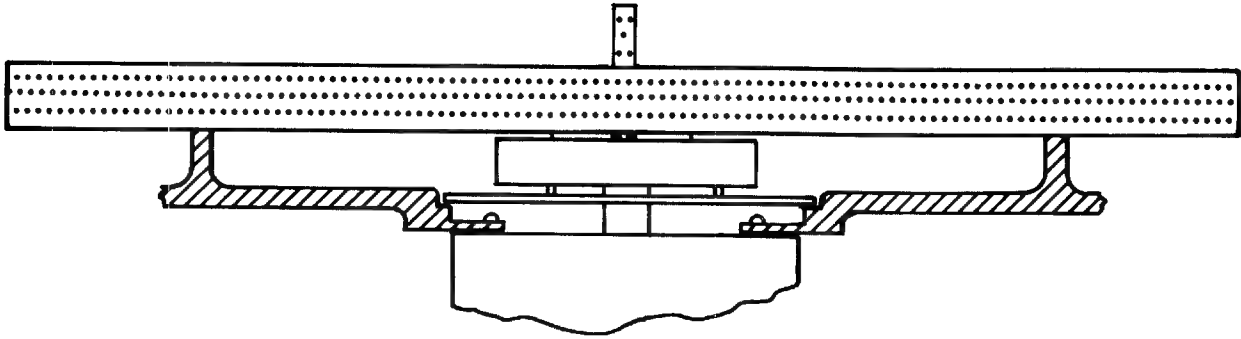


Figure 4-16. Takeup Hub Adjustment

COMPLIANCE ARM ASSEMBLY (9 Figure 4-5), AIR CAPACITOR ASSEMBLY (9, Figure 4-6).

NOTE

To facilitate removal of the compliance arm assembly, this procedure combines the removal, disassembly, assembly and installation of the compliance arm assembly with that of the air capacitor.

4-30. Removal and Disassembly (Figure 4-17). Place the transport in service access position (paragraph 4-3). Proceed as follows:

NOTE

Save all attaching parts for use in reassembly.

- a. Remove the top plate air duct (paragraph 4-41). Do not remove Ty-rap.
- b. Remove two screws (1), lockwashers (2) and flat washers (3) attaching air capacitor shutter blade (4) to hub (5), and remove blade (4) from air capacitor stator (8).
- c. Remove wire terminals clipped to air capacitor stator (8) plates and identify for reassembly.
- d. Remove two allen-head screws (6) and one allen-head screw (7), and remove air capacitor stator (8) from top plate.
- e. Loosen socket head screw (9) and remove shutter hub (5) from end of compliance arm shaft.
- f. From top side of plate, remove spring (10) from bracket (11).
- g. From bottom side of top plate, remove retaining ring (12), wavespring washer (13), and shim (14). Lift compliance arm assembly from top plate. Remove lower bearing (15) or upper bearing (16) only if it requires inspection and/or replacement. These bearings are attached to top plate with Loctite 601.

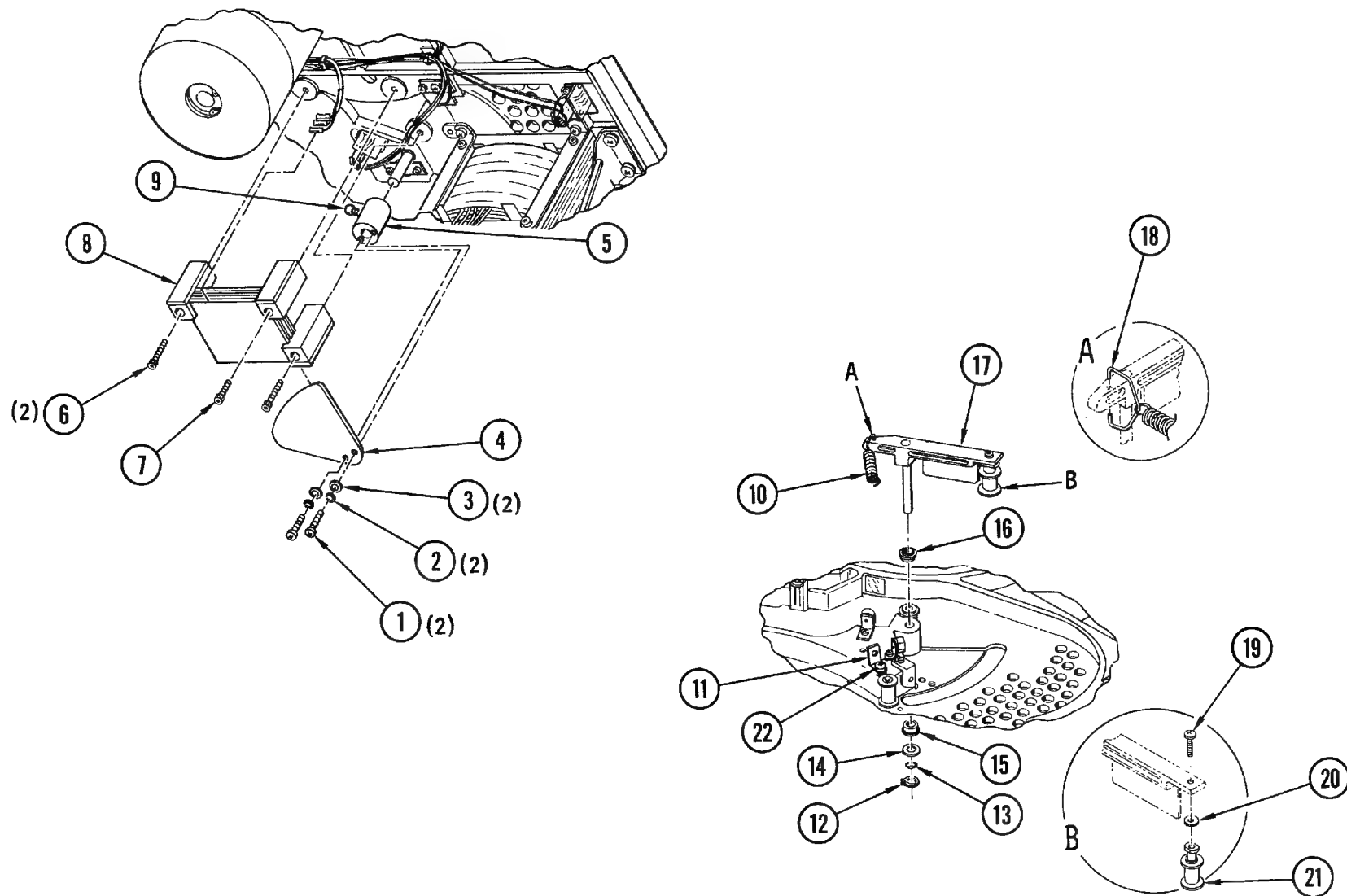


Figure 4-17. Compliance Arm and Air Capacitor Assemblies

- h. Remove clip (18) from arm (17) by spreading ends out of hole in arm.
- i. To remove tape guide (21), remove screw (19), and shim (20), saving shim for reassembly.

4-31. **Reassembly, Installation, and Adjustment.** Reassemble and install the compliance arm and air capacitor assemblies as follows:

- a. Replace defective parts and reassemble compliance arm assembly as shown in Figure 4-17, in reverse order of steps g through i, paragraph 4-30, observing the following special instructions.
 - (1) Use attaching parts and shims saved from removal and disassembly as necessary.
 - (2) Apply Lubriplate to bearing surfaces between clip (18) and arm (17).
- b. If bearing (15) or (16) was removed, apply small amount of Loctite 601 around outside of bearing and replace.
- c. Install shaft carefully through bearings in top plate.
- d. Install shim (14), wavespring washer (13), and retaining ring (12) on bottom of shaft. Check wavespring washer (13) to see that it is compressed half of its height. If not, add shims (14) as necessary, checking compliance arm for freedom of movement.
- e. Slip hub (5) of capacitor shutter over end of compliance arm shaft, tightening socket head screw (9) just enough to hold hub on shaft.
- f. Mount air capacitor stator (8) to under side of top plate with one screw (1/2 - inch) (7), and two screws (5/8-inch) (6), applying Loctite 242 to screws before insertion.
- g. Slip blade (4) of capacitor shutter between two upper plates of capacitor stator (8), and attach to hub (loosen hub if required) with two screws (1), lockwashers (2), and flatwashers (3).
- h. Rotate compliance arm assembly to front bumper and secure with Ty-rap.
- i. Loosen hub socket head screw (9) slightly, rotate capacitor shutter blade (4) to within 0.1 inch of power supply housing, and adjust height of hub so that rotor blade does not bind on either plate of capacitor stator (8).
- j. Tighten hub socket head screw (9).
- k. Remove Ty-rap securing compliance arm assembly to front bumper and allow compliance arm to rotate to rear bumper (under its own weight). If compliance arm does not swing freely, readjust height of capacitor shutter, steps i and j, until compliance arm swings freely.
- l. Tighten hub socket head screw (9).
- m. Attach compliance arm spring (10) to bracket (11).

- n. Clip wire terminals to air capacitor stator (8) plates at points from which removed in step b, paragraph 4-30.
- o. Place transport in operator maintenance access position (paragraph 4-2).

CAUTION

To prevent data reliability problems due to improper tape tensioning, the position of the compliance arm spring bracket (11) is factory aligned and should not be changed unless necessary.

- p. If spring bracket position was changed, adjust for proper spring tension as follows:
 - (1) Attach 0 to 36 oz. spring scale, available from John Chatillon & Sons, 83-30 Kew Gardens Rd., Kew Gardens, New York 11415, Part No. LP36, to compliance arm by inserting hook end of scale into notch provided on top of compliance arm near the pivot point.
 - (2) Loosen screw (22) attaching bracket (11) and position bracket so that screw (22) is in the center of its slotted adjustment range.
 - (3) Pull spring scale toward front panel of transport until compliance arm roller is positioned between 4th and 5th row (from front panel) of holes in top plate. Scale must be held perpendicular to compliance arm.
 - (4) With compliance arm positioned between 4th and 5th holes in top plate, spring scale should indicate 19 (± 2) ounces. Adjust spring bracket to obtain this reading by moving bracket to stretch or shorten spring. Any deviation from zero reading should be added or subtracted from spring scale reading.
 - (5) Verify that minimum spring tension required to move arm from rest position is 10 ounces.
 - (6) If readjustment is required in either substep (4) or (5), reverify both readings.
- q. Use Service Aid 24 to test compliance arm and air capacitor assemblies.

TAPE-IN-PATH SENSOR, TRANSMITTER (10, Figure 4-5).

4-32. Removal and Replacement (Figure 4-18). Place the transport in service access position (paragraph 4-3) and proceed as follows:

- a. Remove connector at back of top plate from tape-in-path sensor transmitter.
- b. Remove two screws (1, Figure 4-18) and lockwashers (2) and pull transmitter (3) carefully through hole from back of top plate.

- c. Position replacement sensor transmitter carefully in place through hole from back of top plate and secure with screws (1) and lockwashers (2).
- d. Attach connector removed in step a.
- e. Place transport in operating position.
- f. Use Service Aid 31 to test tape-in-path sensor, transmitter.

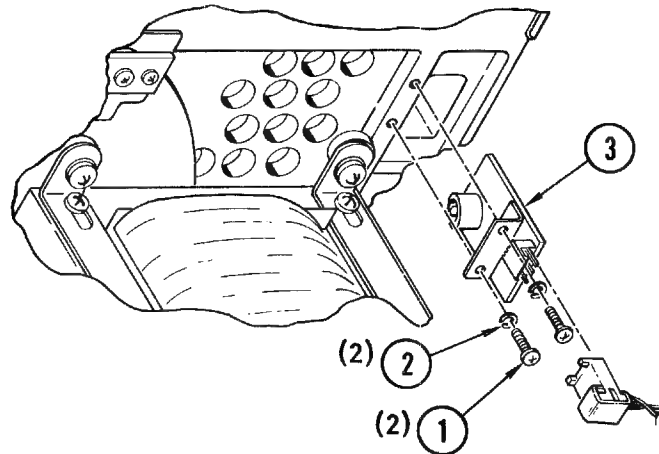


Figure 4-18. Tape-in-Path Sensor, Transmitter

TAPE-IN-PATH SENSOR, RECEIVER (11, Figure 4-5).

4-33. Removal and Replacement (Figure 4-19). Place the transport in service access position (paragraph 4-2) and proceed as follows:

- a. Remove connector at back of top plate.
- b. Remove attaching screw (1, Figure 4-18), lockwasher (2), and flatwasher (3) and remove tape-in-path sensor receiver (4). Save attaching parts for reassembly.
- c. Install replacement receiver using screw (1), lockwashers (2) and flatwasher (3).
- d. Reinstall connector.
- e. Place transport in operating position.
- f. Use Service Aid 31 to test tape-in-path sensor, receiver.

COMPLIANCE ARM BUMPER ASSEMBLY (12, Figure 4-5).

4-34. Removal and Replacement (Figure 4-20). With the transport in operator maintenance position (paragraph 4-2), proceed as follows:

- a. Remove screw (1, Figure 4-20), lockwasher (2), and bumper assembly (3).

- b. Reinstall in reverse order of removal, and adjust to contact compliance arm squarely. Ensure spring (4) does not touch bumper in the compliance arm's full arc of travel. Reposition bumper to clear spring if required.
- c. Place transport in operating position.

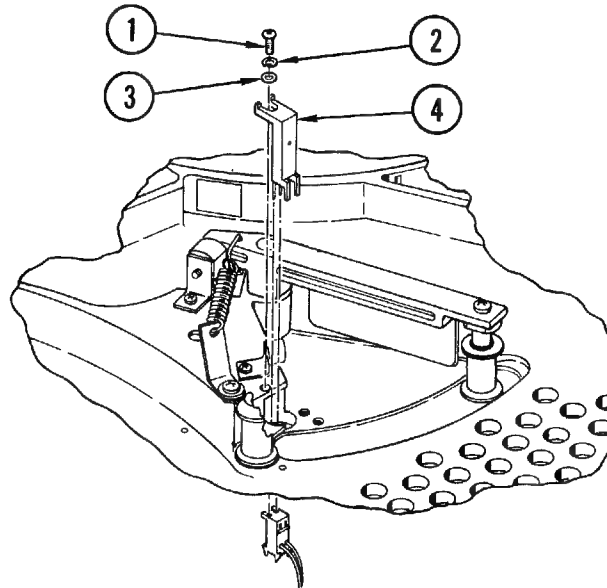


Figure 4-19. Tape-in-Path Sensor, Receiver

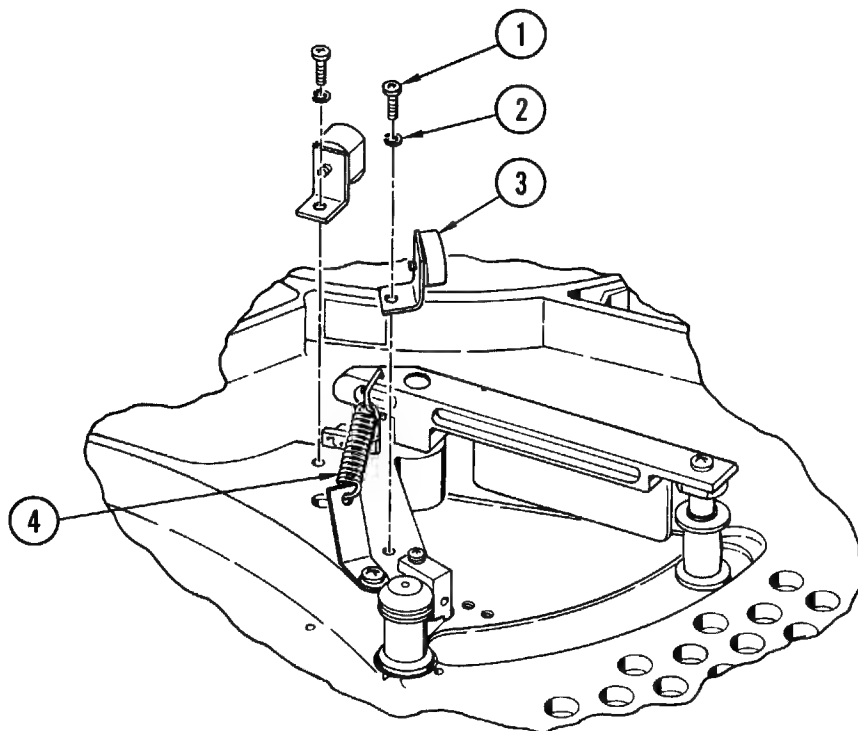


Figure 4-20. Compliance Arm Bumper Assembly

ROLLER TAPE GUIDE ASSEMBLY (SOLID) (13, Figure 4-5).

4-35. Removal and Replacement (Figure 4-21). Place the transport in service access position (paragraph 4-3) and proceed as follows:

- a. Remove attaching screw (1, Figure 4-21) and lockwasher (2), and leaving shims in place remove tape guide assembly (solid) from top of top plate. Save attaching parts for reinstallation.
- b. Reinstall tape guide assembly (solid) (3) in reverse order of step a.
- c. Perform tape alignment procedure in accordance with instructions in paragraph 4-50.

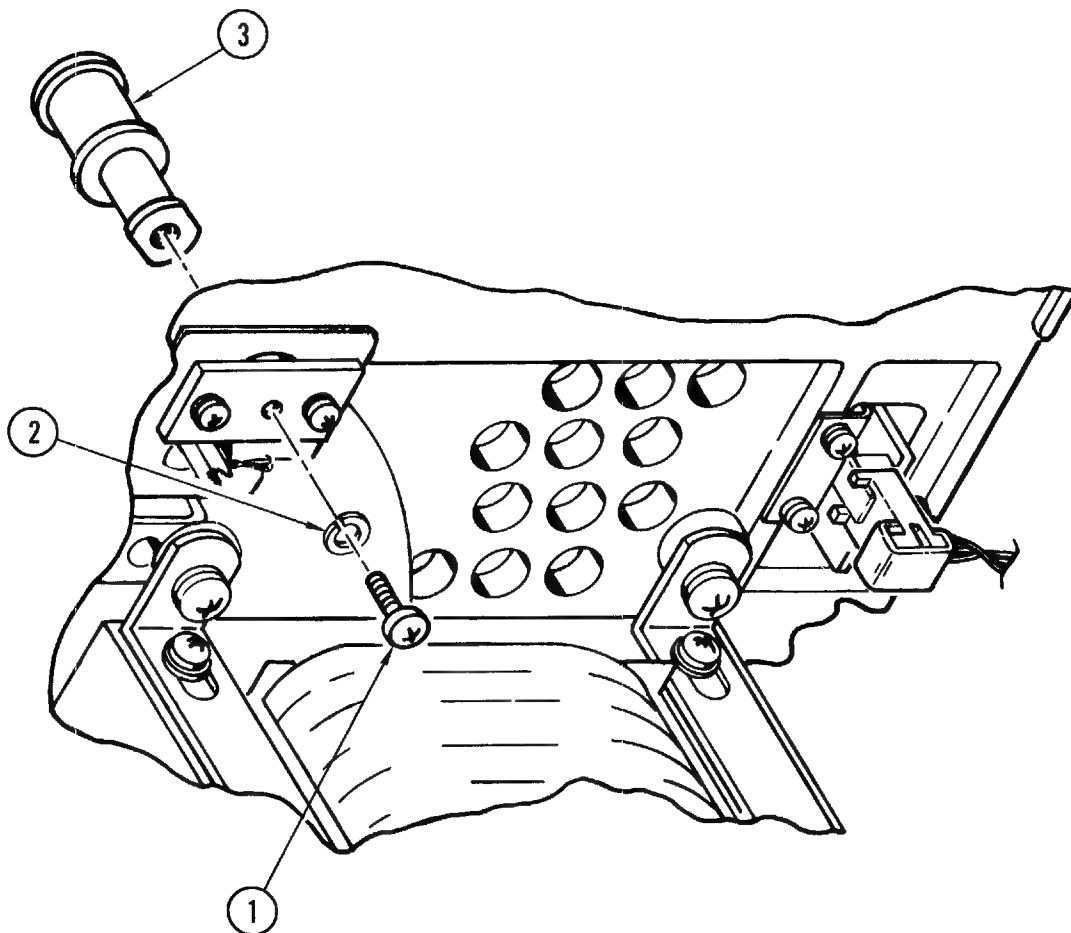


Figure 4-21. Tape Guide Assembly (Solid)

FILE-PROTECT SENSOR (14, Figure 4-5).

4-36. **Removal and Replacement (Figure 4-22).** Place the transport in service access position (paragraph 4-3) and proceed as follows:

- a. Remove connector (back of top plate) from file-protect sensor (3, Figure 4-22).
- b. Remove two screws (1) and lockwashers (2) and pull sensor (3) carefully through hole of top plate. Save attaching parts for reassembly.
- c. Position replacement sensor carefully through hole and secure with screws (1) and lockwashers (2).
- d. Attach connector removed in step a.
- e. Place transport in operating position.
- f. Use Service Aid 3I to test file-protect sensor.

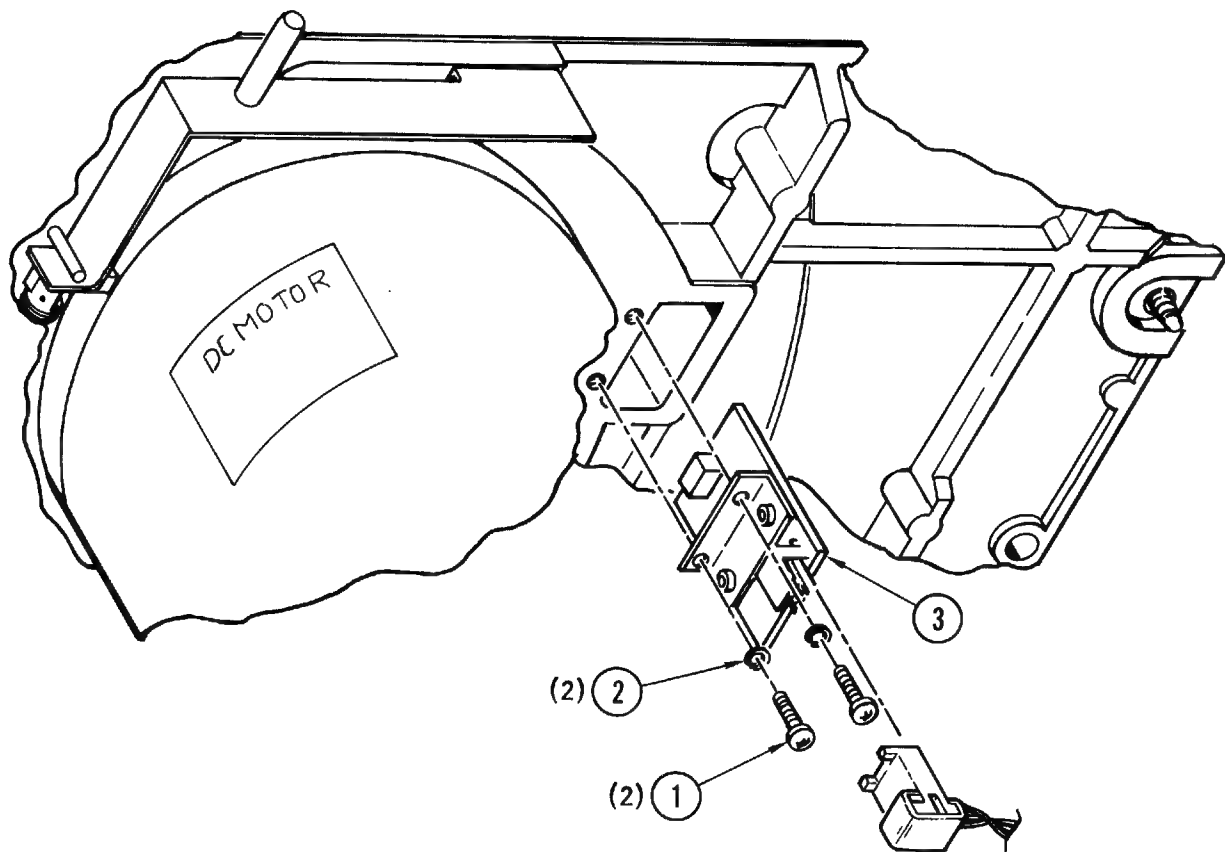


Figure 4-22. File-Protect Sensor

DRIVE MAIN PRINTED WIRING BOARD (PWB) ASSEMBLY (I, Figure 4-6).

4-37. **Removal and Replacement (Figure 4-23).** Place the drive in service access position (paragraph 4-3) and proceed as follows:

- a. Remove power cord from outlet.
- b. Remove screw (1), lockwasher (2), and flat washer (3) from front center of board.
- c. Remove all side connectors and ground wire.
- d. Lift front of board over lip on chassis, slide forward and remove I/O connectors.
- e. Remove board from chassis.
- f. Position replacement board and install I/O connectors.
- g. Reconnect all side connectors and ground wire.
- h. Secure board with screw (1), lockwasher (2), and flat washer (3).
- i. Place transport in operating position.

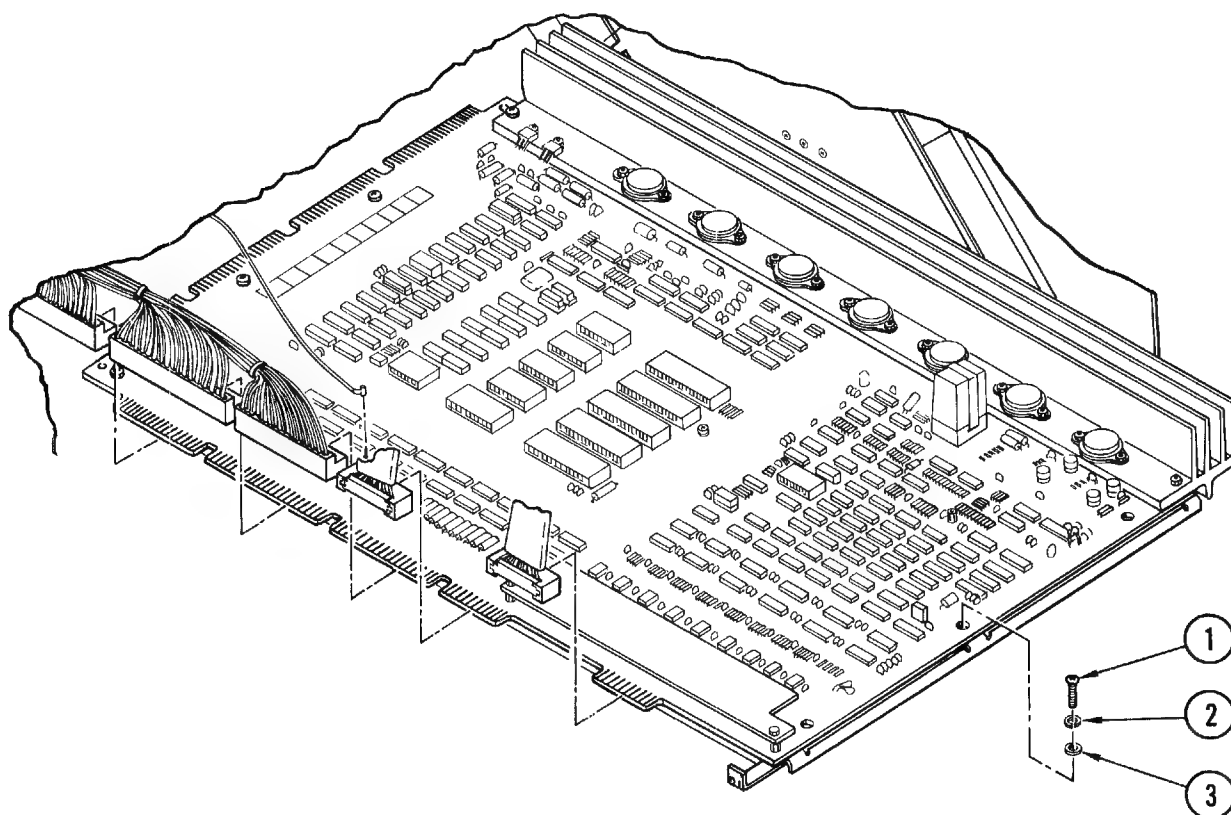


Figure 4-23. Drive Main Printed-Wiring Board

POWER SUPPLY ASSEMBLY (2, Figure 4-6).

4-38. Removal and Replacement (Figure 4-24). Place the drive in service access position (paragraph 4-3) and proceed as follows:

- a. Turn power off and remove power cord from rear of power supply chassis.
- b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

NOTE

Although not required, the following steps are simplified by removal of the top plate air duct (paragraph 4-41), front panel air duct (paragraph 4-42) and air intake tube (paragraph 4-43).

- c. Remove screw (1, Figure 4-24), lockwasher (2), and flatwashers (3) securing ground wire terminal (4), and power supply cover (5).
- d. Cut Ty-raps (5 places) securing wiring harness to outside of power supply chassis, and disconnect wiring harness connector from power supply PWB.
- e. Remove screws (6), lockwashers (7), and flatwashers (8) securing power supply chassis to top plate.
- f. Remove screws (9), lockwashers (10), and flatwashers (11) securing chassis to rear bracket.
- g. Disconnect air pump wires (16) and terminals from EMI filter (15) noting position from which removed.
- h. If air pump assembly (20) is to be replaced, remove nuts (17), lockwashers (18), and flatwashers (19) securing air pump to chassis.
- i. Install replacement assembly in reverse order of removal ensuring transformer and power switch wire bundles are routed through the housing opening near the top plate.

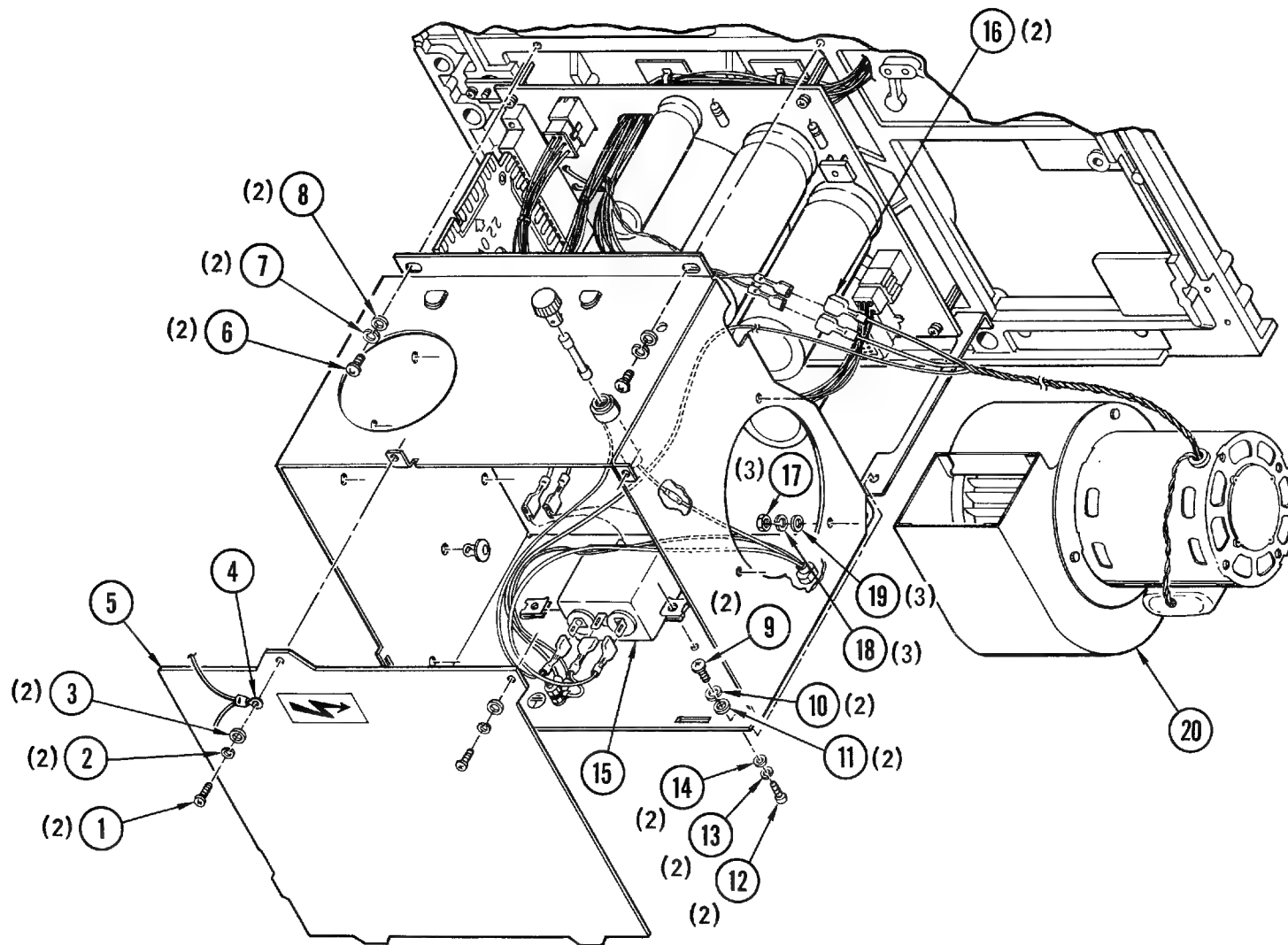


Figure 4-24. Power Supply Assembly

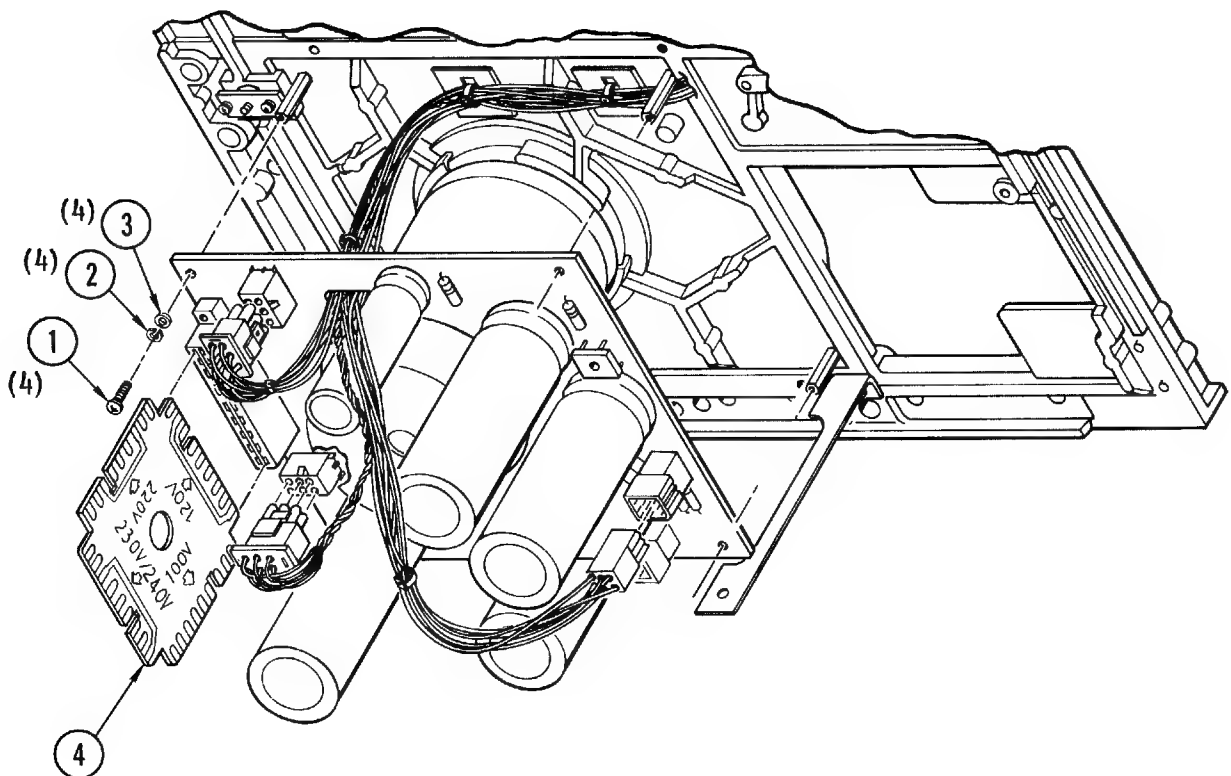


Figure 4-25. Power Supply PWB

POWER SUPPLY PWB (3, Figure 4-6).

4-39. Removal and Replacement (Figure 4-25). Place the drive in service access position (paragraph 4-3) and proceed as follows:

- a. Remove power cord from outlet.
- b. Remove drive main PWB in accordance with instructions in paragraph 4-37.
- c. Remove power supply assembly in accordance with instructions in paragraph 4-38.
- d. Disconnect all wiring harness connectors from power supply PWB.
- e. Remove screws (1), lockwashers (2), and flatwashers (3), and carefully lower power supply PWB while feeding cables through board opening. Remove voltage selection card (4).
- f. Reconnect all connectors to replacement PWB and replace voltage selection card (4).
- g. Hold PWB in place and secure with screws (1), lockwashers (2), and flatwasher (3).
- h. Replace power supply chassis in reverse order of instructions in paragraph 4-38.
- i. Place drive in operating position.

TAKEUP MOTOR ASSEMBLY (4, Figure 4-6).

4-40. Removal, Replacement and Adjustment (Figure 4-26). Place the transport in service access position (paragraph 4-3) and remove and replace the takeup motor assembly in accordance with the following procedure:

- a. Remove power cord from outlet.
- b. Remove drive main PWB in accordance with instructions in paragraph 4-37.
- c. Remove takeup hub in accordance with paragraph 4-29.
- d. Remove power supply assembly cover in accordance with instructions in paragraph 4-38.
- e. Disconnect motor wire terminals identifying as necessary for reinstallation.
- f. Remove four screws (1, Figure 4-26), lockwashers (2), flatwashers (3), shoulder washers (4), and takeup motor (6) out of drive, noting orientation of motor. Save attaching parts, including insulator (5), for use in assembly.

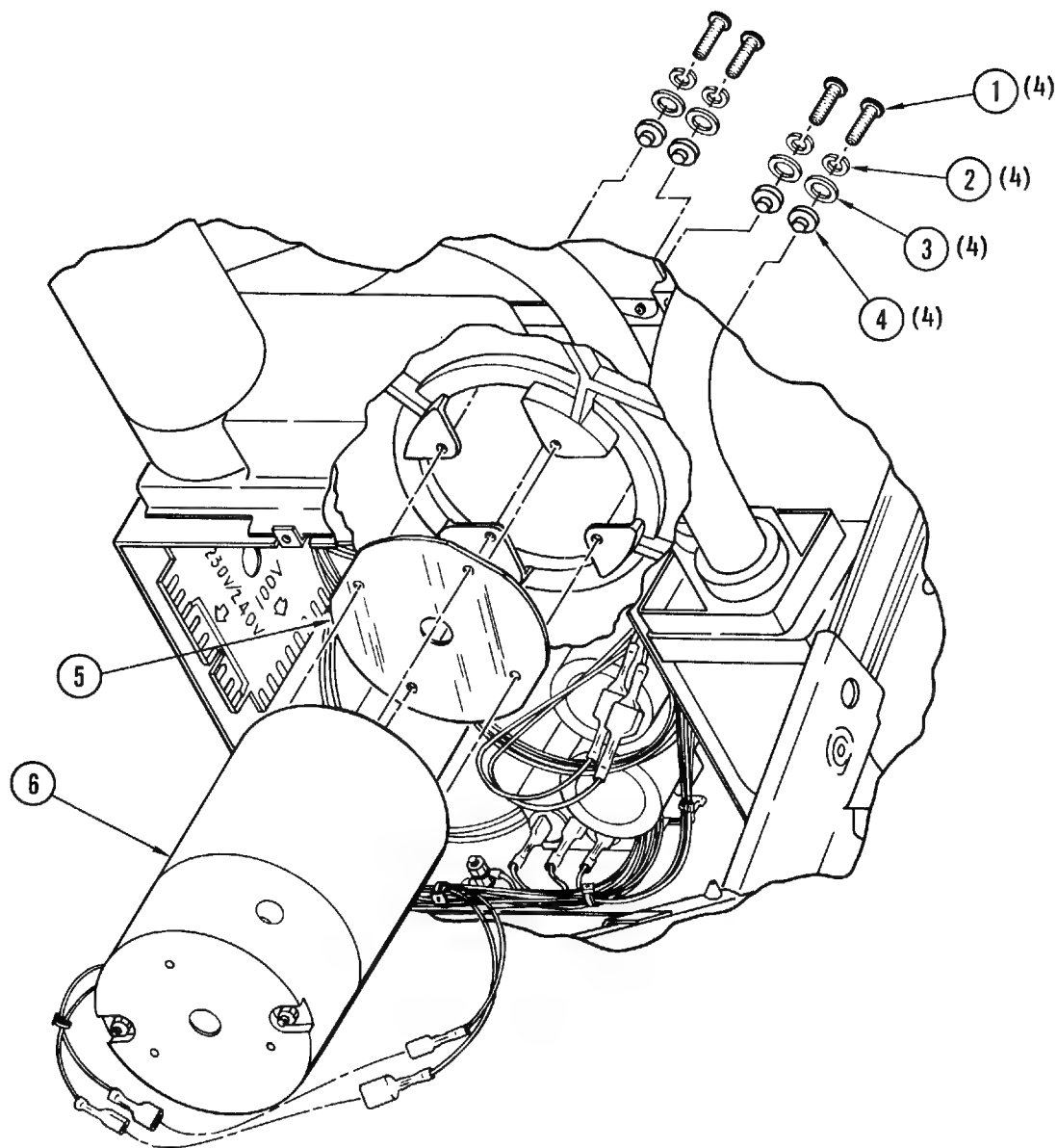


Figure 4-26. Takeup Motor Assembly

- g. Install replacement motor in same orientation as motor removed in step f, in reverse order of steps e and f.
- h. Reinstall power supply cover in accordance with instructions in paragraph 4-38.
- i. Reinstall and adjust takeup hub in accordance with paragraph 4-29.
- j. Reinstall main PWB in accordance with instructions in paragraph 4-37.
- k. Use Service Aid II to test motor operation.

AIR DUCT, TOP PLATE (5, Figure 4-6), AIR DUCT, FRONT PANEL (6), TUBE, AIR INTAKE (7).

4-41. Removal and Replacement (Figure 4-27). Place the transport in service access position (paragraph 4-3). To replace the top-plate air duct, proceed as follows:

- a. Remove head connectors J6/J7 from main PWB and cable retractor (5). At top-plate end of top-plate air duct (4), remove screw (1), lockwasher (2), and flatwasher (3).
- b. Pull other end from blower adapter (6), and remove air duct.
- c. Remove cable retractor (5) from old duct and secure with Ty-rap on replacement duct.
- d. Install replacement duct by slipping flared end over blower adapter (6) and reinstalling screw, lockwasher and flat washer.
- e. Place transport into operating position.

4-42. Front Panel Air Duct (Figure 4-27). Replace the front panel air duct as follows:

- a. Note positions of power switch harness and safety pin retractor Ty-raps on duct and remove.
- b. Remove front panel in accordance with instructions in paragraph 4-21, steps a, b, and c, but do not remove switch wire terminals and connectors.
- c. Pull front panel just far enough away from transport to remove gooseneck end of front-panel air duct (7), noting position from which removed with reference to air deflector on front, right-hand edge of top plate.
- d. Pull other end of duct off blower adapter (6).
- e. To install replacement front-panel air duct (7), place flared end of duct on blower adapter.
- f. Position gooseneck end of duct so that it opens into air deflector and holding end of duct in place, replace front-panel assembly, squeezing positioning block of front-panel over gooseneck, ensuring that air intake tube (8) is in place in front-panel adapter (9) and power supply.
- g. Reinstall front panel assembly in accordance with paragraph 4-21, step f.
- h. Fasten power switch wiring harness and safety pin retractor to duct with Ty-raps according to step a.
- i. Place transport in operating position.

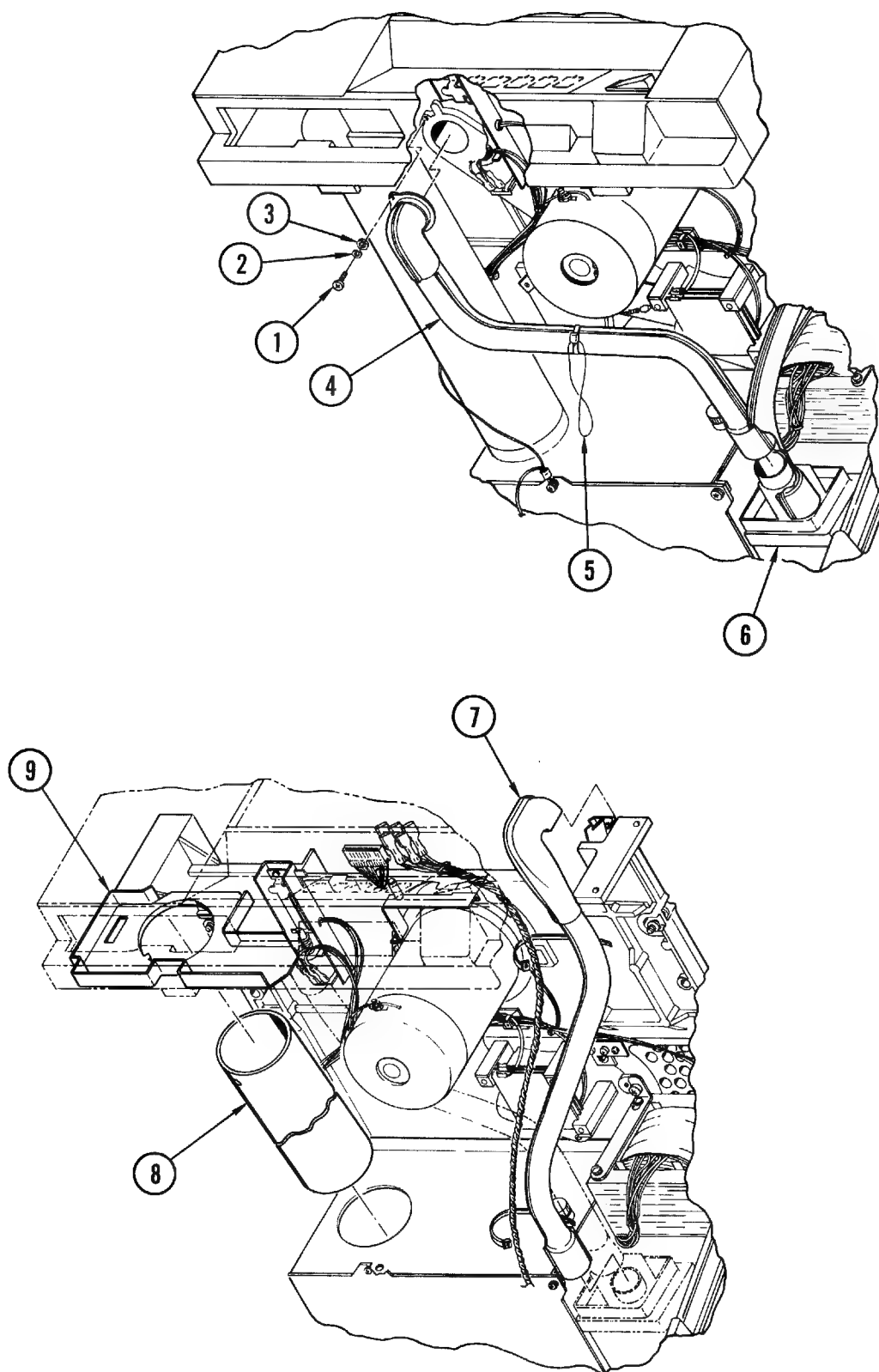


Figure 4-27. Top Plate Air Duct,
Front Panel Air Duct, Air Intake Tube

4-43. Air Intake Tube. (Figure 4-27). Replace the air intake tube as follows:

- a. Remove the filter. Refer to paragraph 4-13.
- b. Place unit in service access position.
- c. Remove air intake tube (8) from power supply case by depressing tube slightly at hole (bottom of tube) to disengage tooth and slide forward into front panel adapter (9).
- d. Remove front panel as in paragraph 4-42, but do not remove Ty-raps, etc.
- e. Slide air intake tube out of front panel adapter.
- f. Install replacement tube in reverse order of removal.
- g. Place transport in operating position.

SUPPLY MOTOR ASSEMBLY (8, Figure 4-6).

4-44. Removal and Replacement (Figure 4-28). Place transport in service access position (paragraph 4-3) and remove and replace the supply motor assembly as follows:

- a. Remove power cord from outlet.
- b. Remove supply hub in accordance with paragraph 4-23.
- c. Disconnect motor wire terminals from wire leads, identifying each as necessary for reinstallation.
- d. Remove bell crank retaining ring (5, Figure 4-28).
- e. Remove screw (1) lockwasher (2), flatwasher (3), shoulderwasher (4), and insulator (6), holding motor (7) as last screw is being removed.
- f. Lower motor (7) from top plate, simultaneously slipping bellcrank off post on top of motor.
- g. Install replacement motor with bellcrank post nearest bellcrank, slipping bellcrank onto post, in reverse order of removal.
- h. Install retaining ring on bellcrank post (paragraph 4-45).
- i. Connect motor wire terminals as identified in step c.
- j. Reinstall and adjust supply hub in accordance with instructions in paragraph 4-23.
- k. Use Service Aid II to test motor operation.

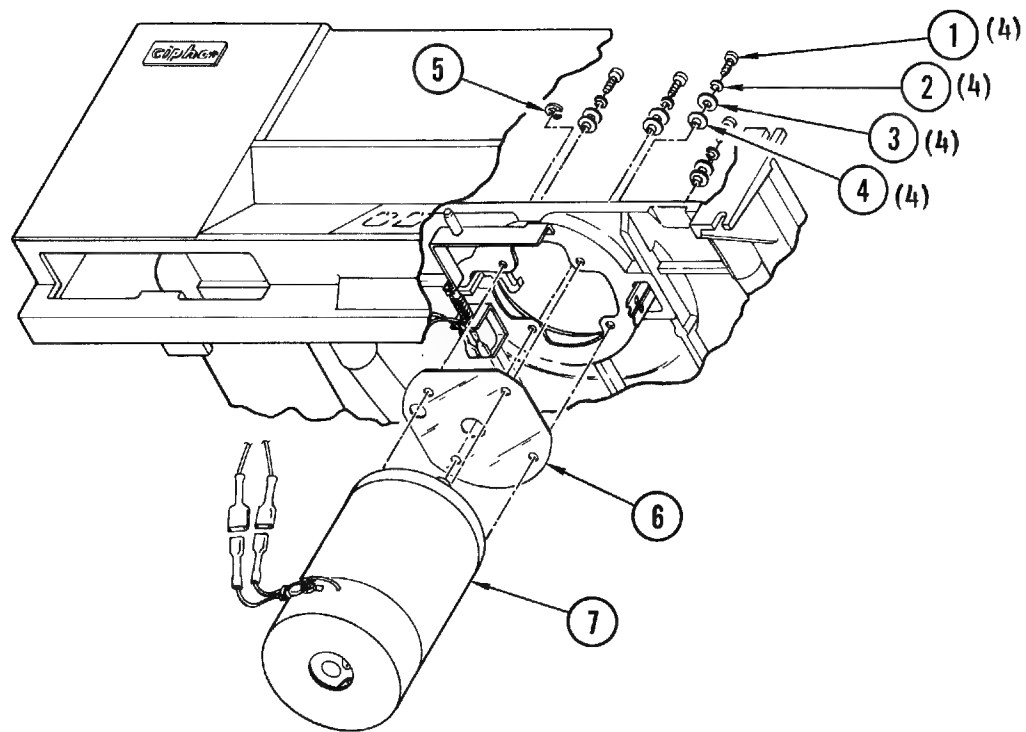


Figure 4-28. Supply Motor Assembly

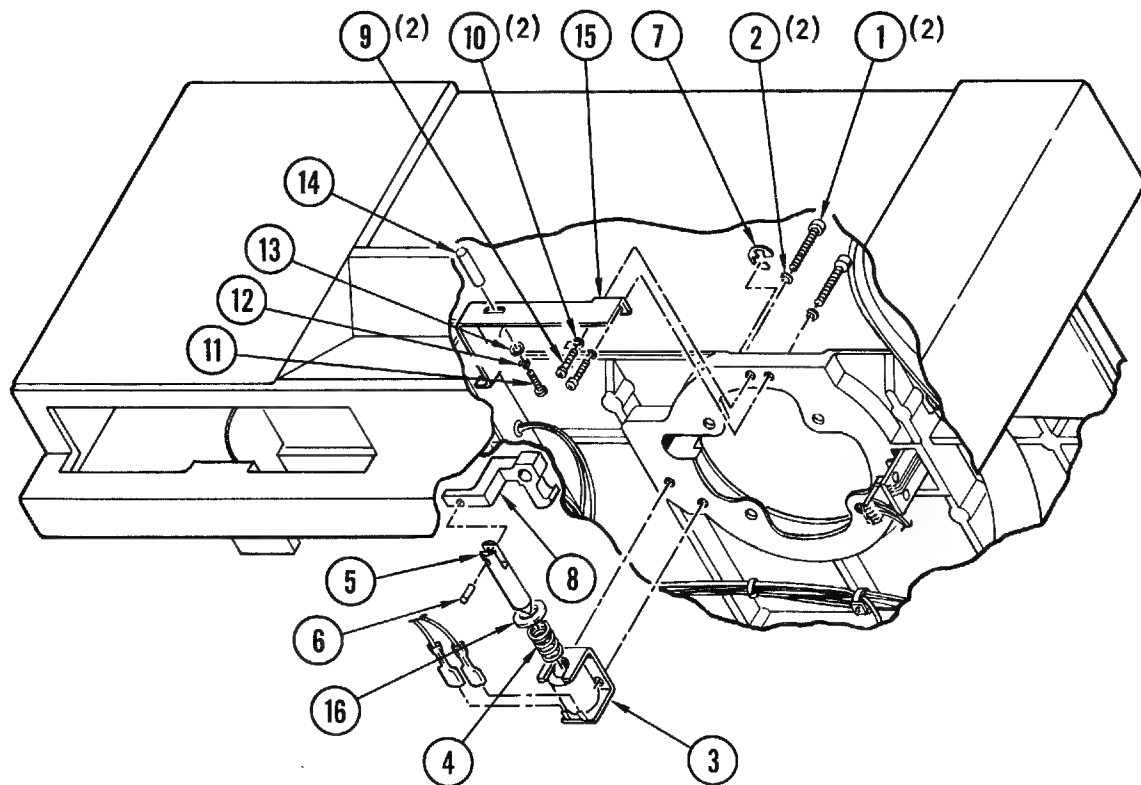


Figure 4-29. Hub Lock Assembly

HUB LOCK ASSEMBLY (10, Figure 4-6).

4-45. Disassembly, Removal and Replacement (Figure 4-27). To disassemble hub lock assembly and remove parts from top plate and supply motor, proceed as follows:

- a. Remove power cord from outlet.
- b. Place transport in service access position (paragraph 4-3).
- c. Remove wire terminals from solenoid (3, Figure 4-29) and identify for reassembly.
- d. Remove two screws (1), and lockwashers (2), and remove solenoid (3) from top plate and spring (4) and washer (16) from solenoid plunger (5).
- e. If plunger (5) or bellcrank (8) must be replaced, remove supply motor in accordance with instructions in paragraph 4-44. Remove retaining ring (7) and bellcrank (8) from motor, and press out pin (6), releasing plunger (5).

4-46. Reassembly and Installation. Replace defective parts, and reassemble and install the hub lock assembly as follows:

- a. Install bellcrank (8) on supply motor with retaining ring (7). Reinstall motor on top plate in accordance with instructions in paragraph 4-44.
- b. Complete reassembly and reinstall solenoid (3) on top plate in reverse sequence of steps c and d, paragraph 4-45.
- c. Place transport in operating position.
- d. Use Service Aid 32 to test hub lock assembly operation.

4-47. Manual Unlock Assembly (Hub Lock) (Figure 4-29). To replace the manual unlock assembly or one of its parts, proceed as follows:

- a. Place transport in service access position (paragraph 4-3).
- b. Remove manual unlock assembly from top plate by removing two screws (9, Figure 4-29) and lockwashers (10).
- c. Remove pin (14) from bracket (15) by removing screw (11), lockwasher (12), and flatwasher (13).
- d. Reassemble and reinstall in reverse order of steps b and c.
- e. Ensure that the hub lock solenoid spring will return the manual unlock assembly fully against the stop pin. Reposition the manual unlock assembly if required.
- f. Place transport in operating position.

DOOR LOCK ASSEMBLY (11, Figure 4-6).

4-48. **Removal and Disassembly (Figure 4-30).** Place the transport in service access position (paragraph 4-3). Remove the door lock assembly from the top plate and disassemble as necessary to replace defective parts as follows:

- a. Remove power cord from outlet.
- b. Remove wire terminals from solenoid noting positions for reassembly.
- c. Remove door lock assembly from top plate by removing two screws (1, Figure 4-30) and lockwashers (2).
- d. Remove slip-on connectors from microswitch noting positions for reassembly and feed through grommet.
- e. Remove two screws (3), and lockwashers (4), and remove solenoid (5) from assembly. Remove spring (6) and spacer (7).
- f. Remove switch (13), by removing two nuts (8), lockwashers (9), flat washers (10), screws (11) and flat washers (12). Switch may then be removed by sliding out solenoid end of bracket.
- g. No further disassembly is recommended.
- h. Replace defective parts, and reassemble door lock assembly in reverse sequence of disassembly, steps c and d.

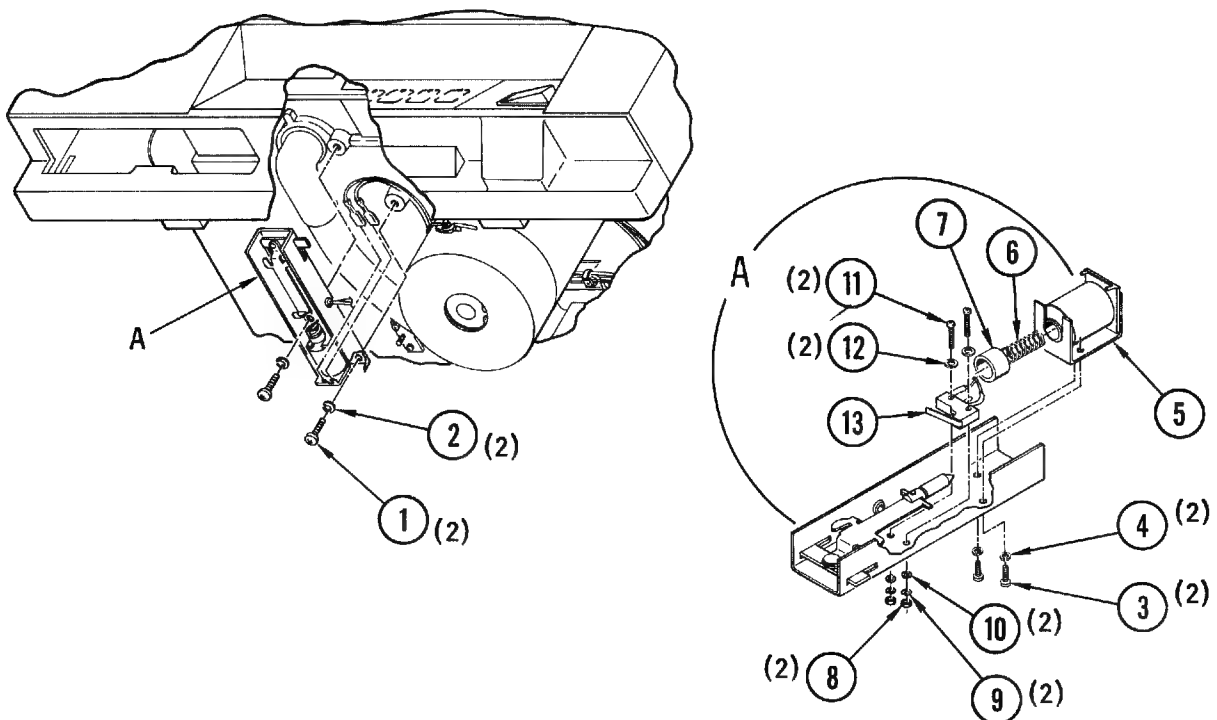


Figure 4-30. Door Lock Assembly

- i. Install door lock assembly on top plate with attaching parts removed in step b. Do not tighten screws.
- j. Adjust position of door lock assembly as follows:
 - (1) Close top cover of transport. Position door lock assembly so that the plate is approximately 1/8-inch in front of latching arm of cover lock tab (6, Figure 4-14), and tighten screws.
 - (2) Applying very light pressure, attempt to close transport door. If door will not close completely, loosen screws (1), push door lock assembly forward until door will close, and retighten screws (1).
 - (3) Place drive in operating position and connect to power source.
 - (4) Actuate POWER switch and LOAD touch switch. If only LOAD and POWER indicators illuminate, door lock assembly is properly positioned and adjustment is complete.
 - (5) If all indicators except ON-LINE are flashing upon execution of step (4), place drive in service access position, loosen screws (1), and pull door lock assembly slightly toward rear of unit.
 - (6) Repeat steps (3), (4), and (5) until both top cover and door open with POWER switch off and only LOAD and POWER indicators illuminate when these switches are actuated.
- k. Place transport in operating position.

TRANSFORMER ASSEMBLY (12, Figure 4-6).

4-49. Removal and Replacement (Figure 4-31). To replace the transformer assembly, place the transport in service access position (paragraph 4-3) and proceed as follows:

- a. Remove power cord from outlet.
- b. Remove drive main PWB from transport (paragraph 4-37).
- c. Remove power supply assembly and power supply PWB in accordance with paragraphs 4-38 and 4-39.
- d. Unplug primary and secondary transformer connectors from power supply PWB, and cut all Ty-raps securing transformer wire bundles to power supply components and other parts of drive, noting position of Ty-raps before removing.
- e. Support transformer (4, Figure 4-31) and remove four screws four (1), four lockwashers (2), and four flatwashers (3), and remove from drive.
- f. Install replacement transformer in reverse sequence of step e.
- g. Replace Ty-raps removed in step c.

- h. Reinstall power supply PWB in accordance with paragraph 4-39, ensuring that transformer wire bundles are properly secured with Ty-raps.
- i. Plug in transformer primary and secondary connectors to power supply.
- j. Reinstall power supply assembly in accordance with paragraph 4-38, and reinstall drive main PWB in accordance with paragraph 4-37.
- k. Place drive in operating position.

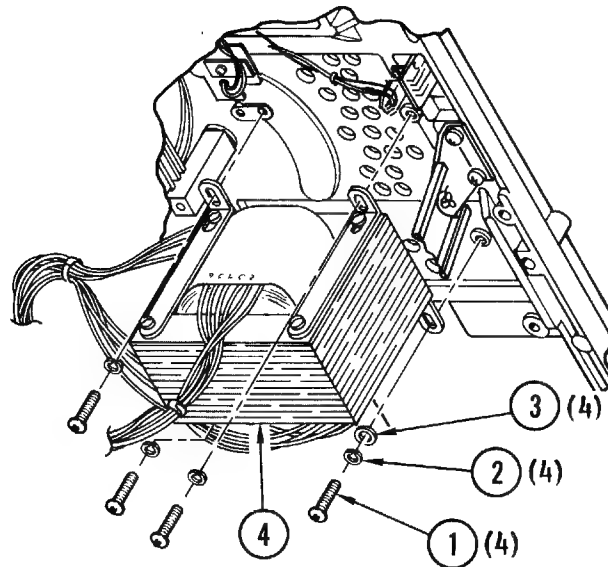


Figure 4-31. Transformer Assembly

TAPE ALIGNMENT

4-50. All tape guides must be checked for proper tape path alignment following replacement of any part in the tape path. Proceed as follows:

- a. Actuate power switch to ON.
- b. Insert and load a new tape.

NOTE

A used tape may have damaged or weak edges which would adversely affect its tape-path tracking characteristics.

- c. Use Service Aid 33 to disable door and top cover lock. Place drive in operator maintenance access position.
- d. Ensure that supply reel is properly seated on supply hub.
- e. Referring to paragraph 3-33, operate drive in Service Aid 23.

- f. If tape is not centered between sides of reel, unload tape and adjust hub height as necessary.
- g. Observe position of tape on roller guide (2, Figure 4-32).
- h. If tape is not centered on guide, turn power switch to OFF, and remove guide (2) from compliance arm in accordance with paragraph 4-30 step i and Figure 4-17.
- i. Add or reduce thickness of shims (20) as required to compensate for off-center position of tape and reinstall guide on compliance arm. Repeat as necessary to obtain correct centering of tape on guide (2).
- j. Run tape forward and check for edge curl on guide (3). If curl is present on lower washer, turn power switch to OFF and increase shims under roller guide (1). If curl is present on upper washer of guides (3), decrease shim thickness under roller guide (1). Resume forward tape motion and recheck tape position. Repeat this step until tape tracks smoothly around guide (3).
- k. Depress lower washer on guide (3) and check for optimum movement of tape away from top washer of 0.005 inch. If necessary, reshim guide (2) to maintain proper tape centering.
- l. Run tape in forward direction and check for edge curl on guide (4). If curl is present, turn transport power to OFF and add or remove shims on guide (5). Do not alter guide (5) more than ± 0.005 inch from factory setting.

NOTE

Curl on guide (4) can be caused by improper alignment on any other guide in the tape path. If tracking has been verified on guide (3), tape curl on guide (4) is probably caused by misalignment of guide (5). Normally, improper alignment of guides (1) and (2) will show up as tracking problems on guide (3).

- m. Run tape in reverse direction (Service Aid 23) and check for tape curl on all edges.
- n. Depress lower washer on guides (3), (4), and (5) and check for optimum tape movement, away from top washer, of 0.005 inch.
- o. Add or delete shims on guides (1), (2) and (5) as required to eliminate edge curl on all rollers and reverify forward tape path alignment by checking for maximum tape shift on guide (2) of ± 0.015 inch.
- p. Check head azimuth and read skew. Refer to paragraph 4-51.

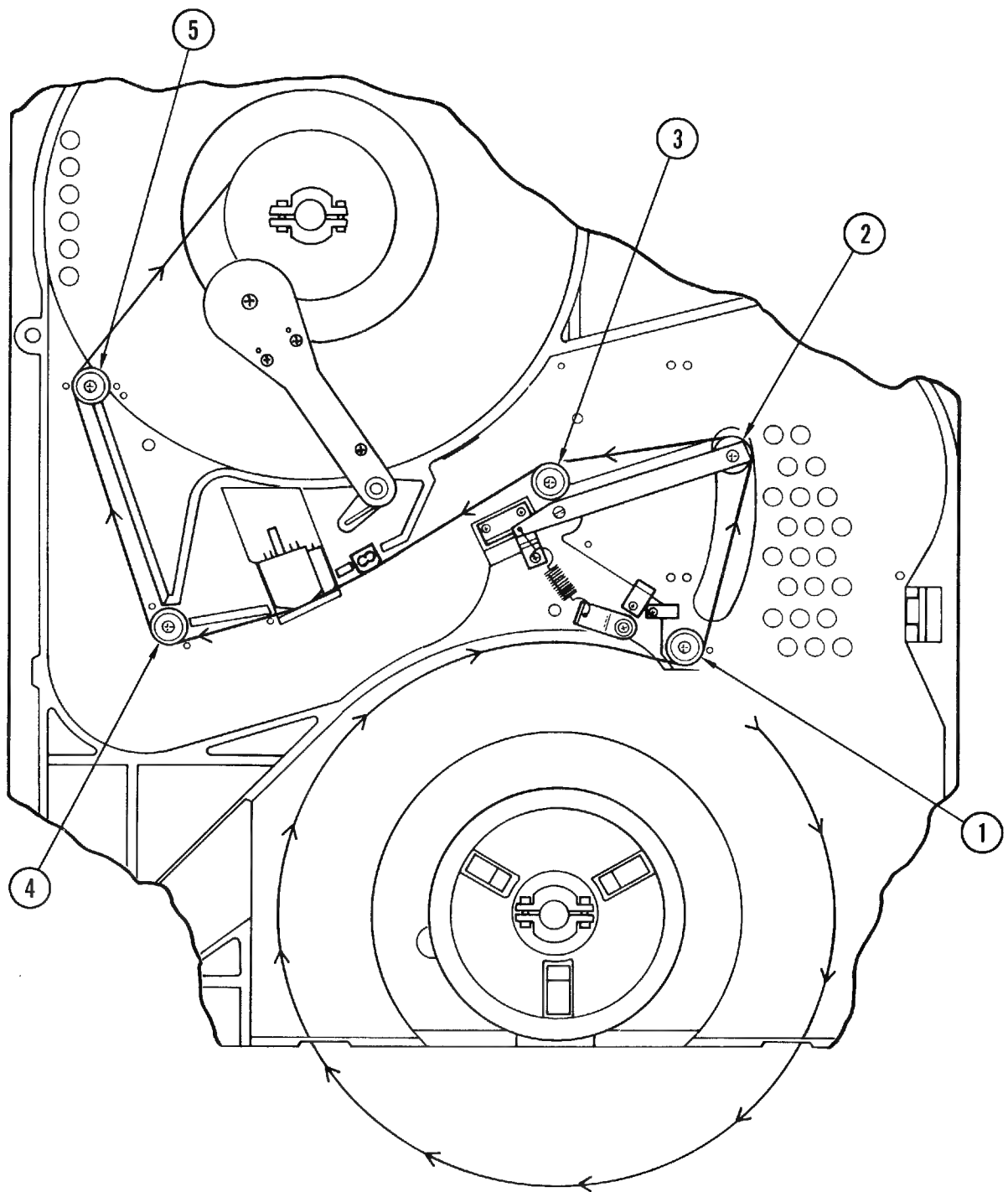


Figure 4-32. Tape Path Adjustment

4-51. Head Azimuth Adjustment. Adjust head azimuth as follows:

- a. Place drive in service access position.
- b. Turn transport power off and attach skew monitor, Cipher Part No. 960067-001 to U14A, U14D, and U14G.
 - (1) A skew monitor may be constructed using three 14-pin IC clips and nine 47K ohm resistors.
 - (2) Attach one end of a resistor to pins 9, 11, and 13 on each IC clip.
 - (3) Connect the other end of all nine resistors together to form a summing junction.
- c. Actuate transport power switch to ON and load master skew tape, Cipher Part No. 799019-401.
- d. Connect oscilloscope to test point on skew monitor and ground test point.
- e. Loosen center adjustment screw (1, Figure 4-11).
- f. Referring to paragraph 3-33, operate drive in Service Aid 23.
- g. Adjust azimuth screw (1, Figure 4-11) so that outputs of all tracks, as monitored at test point on skew monitor, fall within 24% or less of the byte-to-byte period. (See Figure 4-33)
- h. Run tape in reverse direction, using Service Aid 23, and verify reverse skew is within 24% or less of the byte-to-byte period.
- i. Alternate tape direction between forward and reverse and optimize skew adjustment by minimizing width of skew pulse.
- j. Apply torque seal, Cipher Part No. 209994-025, to head of adjustment screw.
- k. Remove skew tape from transport and load a Pericomp tracking tape, available from Pericomp Corporation, Natick, Massachusetts 01760.
- l. Connect oscilloscope to TP10 and ground.
- m. Run tape in forward direction (Service Aid 23) and compare P1 and P2 on oscilloscope trace. See Figure 4-34.
- n. Calculate difference in amplitude (positive peak) between P1 and P2 and refer to Table 4-3 for conversion of volts to inches. If P1 is greater than P2, subtract calculated figure from 0.007 inch. If P2 is greater than P1, add figure to 0.007 inch. Reference edge must be 0.007 ± 0.003 inch.
- o. Remove skew monitor and place drive in normal operating position.

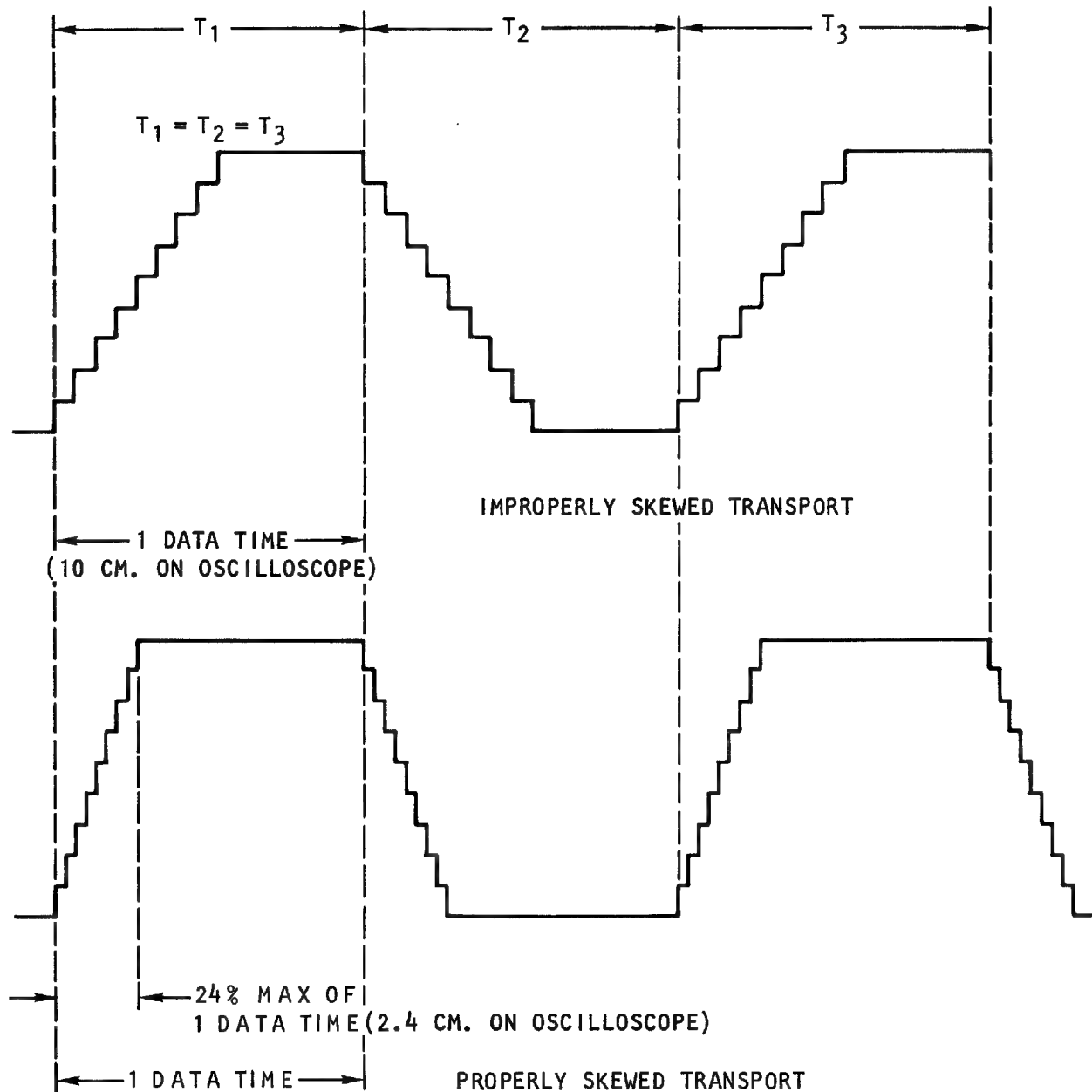
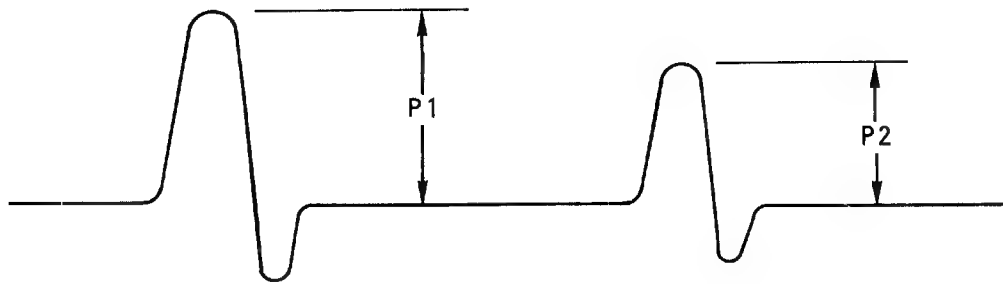


Figure 4-33. Skew Adjustment Waveform

VOLTS	INCHES
0.000 TO 0.024	0.000
0.025 TO 0.049	0.001
0.050 TO 0.074	0.002
0.075 TO 0.100	0.003

Table 4-3. Reference Edge Distance

Figure 4-34. Reference Edge Measurement Waveform (TP10)
Using Pericomp Tracking Tape

SECTION V

ILLUSTRATED PARTS BREAKDOWN

INTRODUCTION

5-1. The illustrated parts breakdown divides the Model M890 Magnetic Tape Streamer Unit into assemblies, subassemblies, and component parts. Component parts are properly indented to show their relationship to the next higher assembly. Attaching parts are listed immediately following the item they attach, and preceding the components of that item.

5-2. Exploded view illustrations serve as a visual aid for identification of component parts of each assembly. Index numbers are used to identify the exploded parts shown. In the case of electronic components (capacitors, resistors, diodes, etc.) on a printed wiring board, a reference designation number is assigned to each, consisting of a capital letter (C for capacitor, R for resistor, etc.) and a sequential number, beginning with the numeral 1 for each capital letter. (Printed wiring boards are not exploded.) When used in conjunction with the schematic diagram and the DESCRIPTION column of the parts list, the reference designation numbers provide data required to troubleshoot, repair, or replace any components.

5-3. Figure 5-1 is an overall view of the magnetic tape transport for use in identifying major assemblies. Figures 5-2 through 5-11 represent both an exploded view of these major assemblies and their relationships to the overall assembly.

5-4. Abbreviations used in this section are defined below.

<u>ABBREVIATION</u>	<u>DEFINITION</u>
A or amp	ampere
al	aluminum
cap	capacitor
dia	diameter
ft	feet (or foot)
hex	hexagon
Hz	Hertz

<u>ABBREVIATION</u>	<u>DEFINITION</u>
ID	inner diameter
in.	inch (or inches)
kV	kilovolt
lg	long
meg	megohm
No. or Nos.	number or numbers
NPN	negative-positive-negative (transistors)
OD	outer diameter
	ohm
PNP	positive-negative-positive (transistors)
pF	picofarad
R	resistor
subs	subsequent
thk	thick
uF	microfarad
v	volt (or voltage)
VDC	volts direct current
VAC	volts alternating current
W	Watt
w/	with
x	by (or names)

EXPLANATION OF THE PARTS LIST

5-5. **FIG. & INDEX NO. Column.** Illustrations are numbered sequentially. The item numbers on each illustration are keyed to the same number appearing in the parts list. If a part number is shown for an item, but no index number is shown, the assembly is immediately broken out below the part number and each item in the assembly is given its own index number. If parts are interchangeable, only one index number will be assigned to the item.

5-6. **PART NUMBER Column.** The number that appears in this column will be a Cipher Data part number in one of two categories: (a) Those parts designed and built by Cipher Data; (b) Those parts procured from outside vendors. Cipher part numbers consist of six digits or six digits with a three-digit dash number. Part numbers beginning with the numerals 1, 3, 4, 5, 6, 7, 8, or 9 are Cipher Engineering or Manufacturing numbers. Part numbers beginning with the numeral 2 are purchased parts from outside vendors. In the case of an electronic component (capacitor, resistor, transistor, etc.), its location in an illustration is determined by the grid system, e.g., transistor UIIF will be found by reading down the sides of the illustration to row number 11, then across the top of the illustration from right to left until the letter F row is reached. Each electronic component assigned a circuit symbol (i.e., reference designation) will have that designation listed in the Figure & Index No. in alphanumeric sequence. Where the sequence is broken due to the removal, revision, or change of a component, the notation "NOT USED" will appear in the DESCRIPTION column opposite the designation that has been removed.

5-7. **DESCRIPTION Column.** Descriptive data as to type, size, color, etc. is provided to fully identify the part when ordering or replacing. Blueprint titles are normally given first, with the basic noun name in capital letters, followed by additional descriptive terms. Acceptable abbreviations are contained in the abbreviation table above.

5-8. **QTY Column.** This column indicates the quantity of each part required for the assembly or subassembly. This quantity is not necessarily the total quantity used for the complete assembly.

NOTE

The same parts may be used in various subassemblies; or in the case of multiple components with attaching hardware, only the quantity of hardware used to attach one item is given.

5-9. **USABLE ON CODE Column.** This column lists the code letter assigned to each of the two current models of the M890 for identification purposes.

<u>CODE</u>	<u>MODEL</u>
A	Model M890 (1600 bpi)
B	Model M890 (3200 bpi)
C	Model M891 (1600 bpi)
D	Model M891 (3200 bpi)

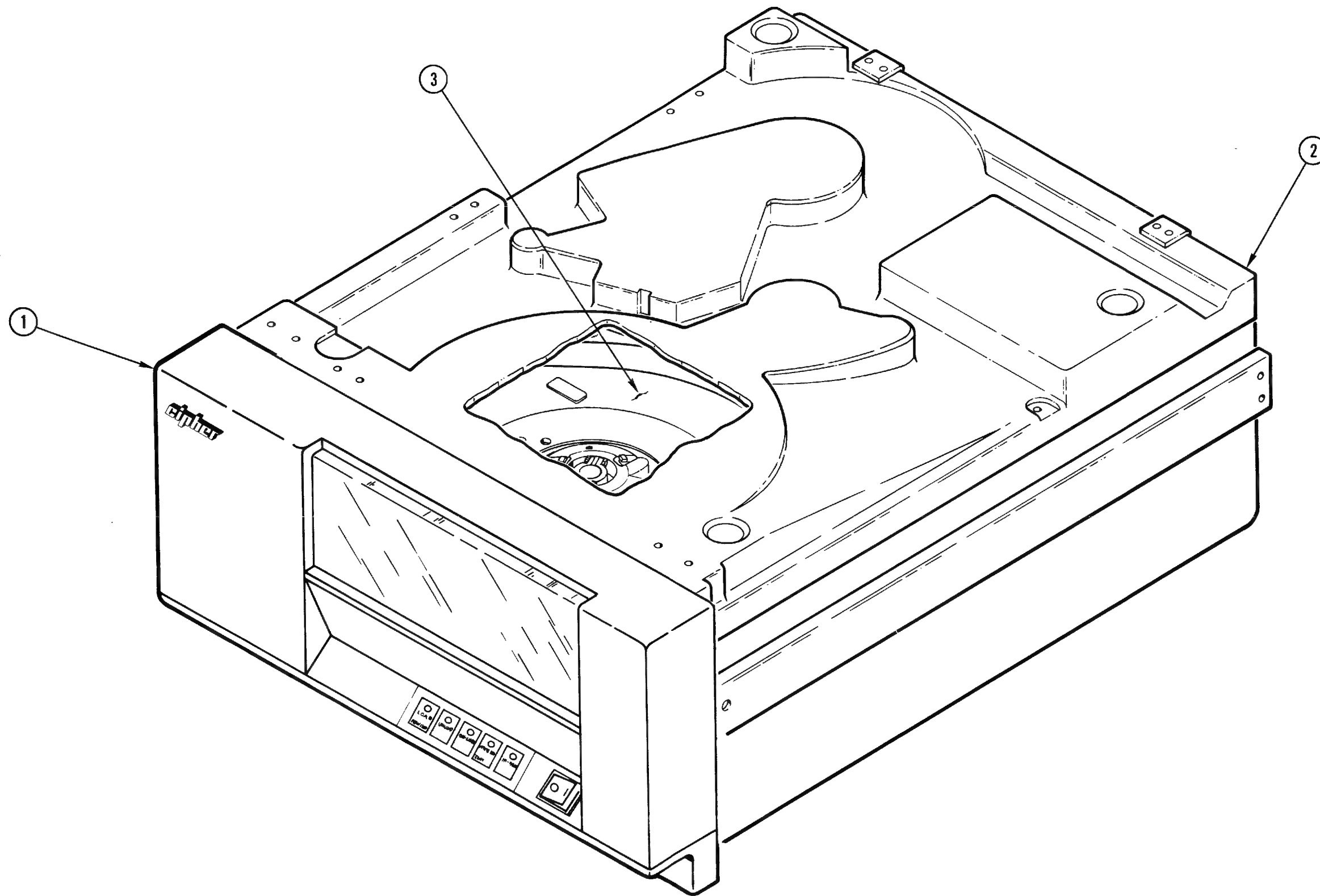


Figure 5-1. CacheTape Unit (Assembled View)

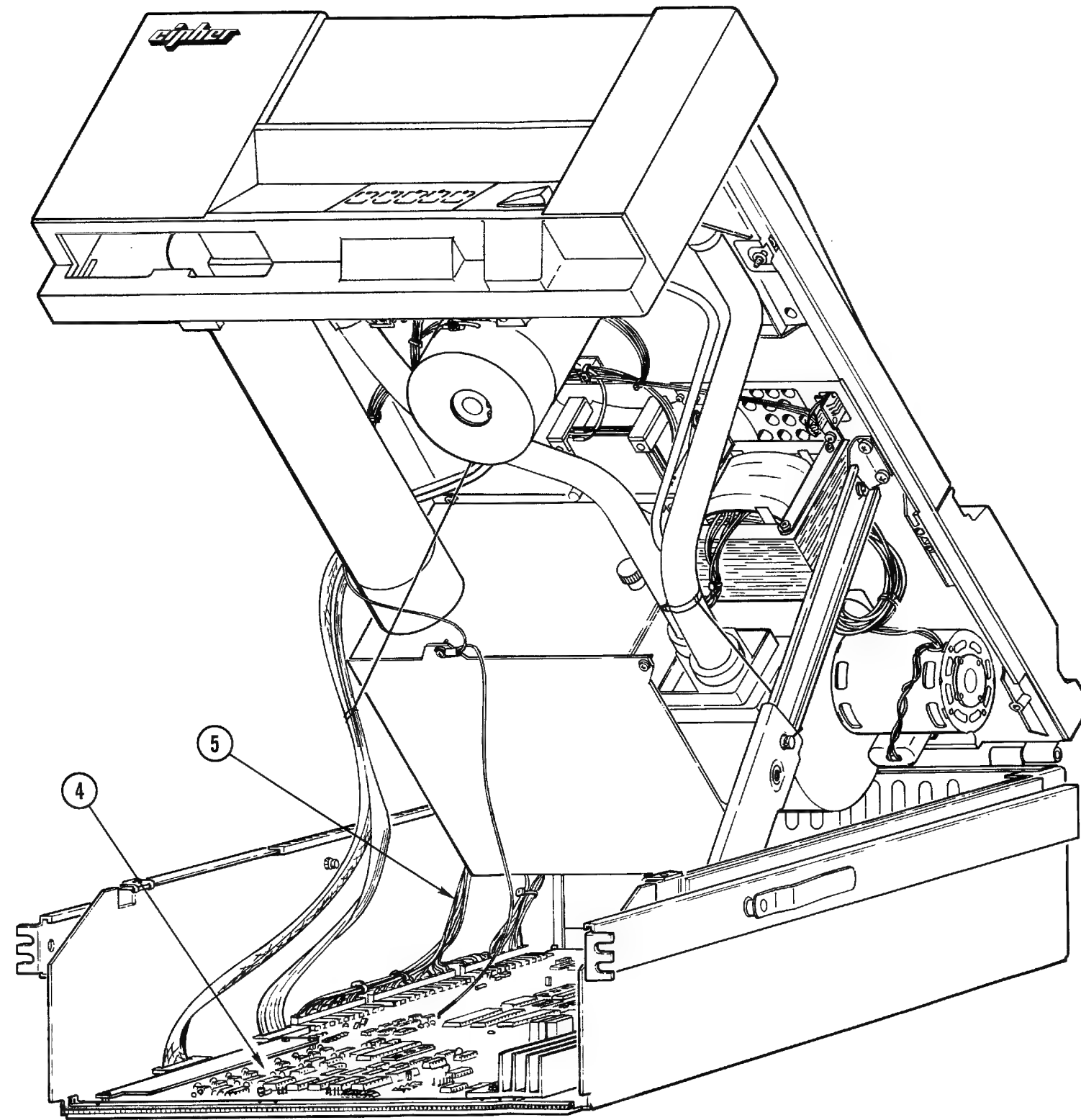


Figure 5-1. CacheTape Unit (Assembled View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-1	960652-003 960654-003 960666-003 960668-003	MAGNETIC TAPE TRANSPORT, (Assembled View) (See Figure 5-2)	REF	A B C D
-1	960359-001	. FRONT PANEL ASSEMBLY (Exploded View) (See Figure 5-3)	1	
-2	960057-001	. TOP COVER ASSEMBLY (Exploded View)..... (See Figure 5-4)	1	
-3	960567-001	. TOP PLATE/CHASSIS ASSEMBLY (Exploded View) (See Figure 5-5)	1	
-4	961019-001 961018-001 961020-001 961017-001	. PRINTED WIRING BOARD ASSEMBLY..... (Exploded View) (See Figure 5-6)	1 1 1 1	A B C D
-5	960629-001	. HARNESS ASSEMBLY (Exploded View)..... (See Figure 5-7)	1	

REVISED _____

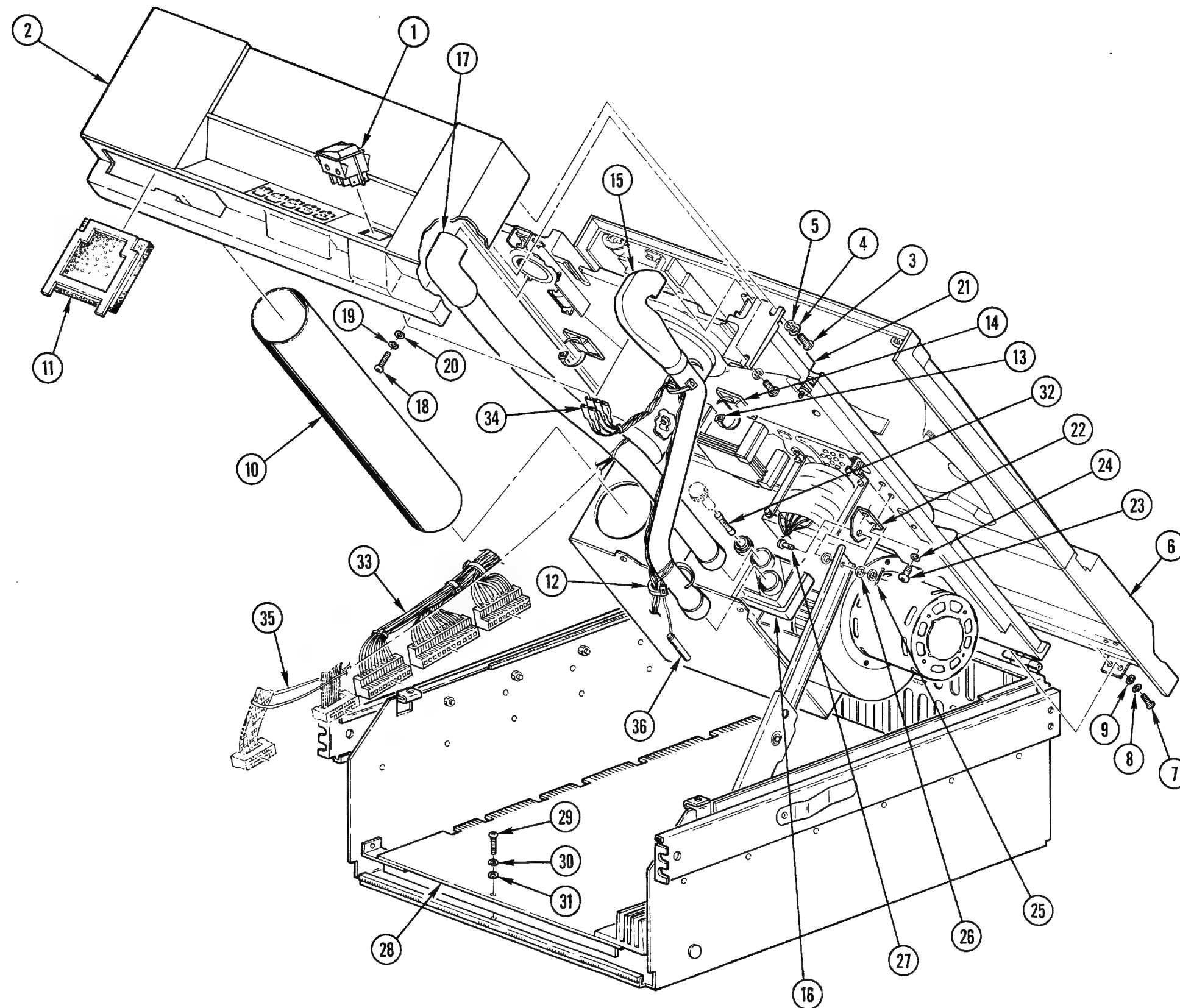


Figure 5-2. CacheTape Unit (Exploded View)

Figure 5-2

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-2	960652-003	MAGNETIC TAPE TRANSPORT, Model M890, 75 ips, 1600 bpi	REF	A
	960654-003	MAGNETIC TAPE TRANSPORT, Model M890, 75 ips, 3200 bpi	REF	B
	960666-003	MAGNETIC TAPE TRANSPORT, Model M891, 125 ips, 1600 bpi	REF	C
	960688-003	MAGNETIC TAPE TRANSPORT, Model M891, 125 ips, 3200 bpi	REF	D
-1	760103-678	. SWITCH, Power, DPST, lighted 16A, 250V,..... UL, CSA, VDE	1	
-2	960359-001	. FRONT PANEL ASSEMBLY (See Figure 5-3 for breakdown) (ATTACHING PARTS)	1	
-3	213271-108	. SCREW, Pan head, phillips..... 10-32 x 1/2 in. lg, cadmium plated, black, zinc	4	
-4	207102-011	. WASHER, Split lock, No. 10 -- -- * -- --	4	
-5	960057-001	. TOP COVER ASSEMBLY (See Figure 5-4 for breakdown) (ATTACHING PARTS)	1	
-6	213271-605	. SCREW, Pan head, phillips..... 6-32 x 5/16 in. lg, cadmium plated, black zinc	4	
-7	207602-011	. WASHER, Split lock, No. 6 -- -- * -- --	4	
-8	207608-021	. WASHER, Flat, small OD, No. 6..... -- -- * -- --	4	
-9	760101-795	. . AIR DUCT (Tube)	1	

REVISED _____

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-2								
-10	960027-001	.	.	FILTER, Air			1	
-11	210229-516	.	.	TY-RAP, 8 in			2	
-12	210229-524	.	.	TY-RAP, 1/16 x 1 1/4 in.			4	
-13	210229-529	.	.	MOUNT, Cable tie, adhesive back			2	
-14	760107-508	.	.	DUCT, Air, front panel			1	
-15	760101-609	.	.	NOZZLE, Blower			1	
-16	760106-554	.	.	DUCT, Air, top plate			1	
				(ATTACHING PARTS)				
-17	213271-805	.	.	SCREW, Pan head, phillips,			1	
				8-32 x 5/16 in. lg, cadmium black, zinc				
-18	207801-021	.	.	WASHER, Flat, No. 8			1	
-19	207802-011	.	.	WASHER, Split lock, No. 8			1	
-20	960567-001	.	.	TOP PLATE/CHASSIS ASSEMBLY			1	
				(See Figure 5-5 for breakdown)				
-21	760101-660	.	.	BRACKET, Support, top plate assembly			1	
				(ATTACHING PARTS)				
-22	213271-106	.	.	SCREW			2	
-23	207102-011	.	.	WASHER, Split lock, No. 10			2	
-24	205042-509	.	.	PIN, Cotter, 1/16 x 1/2 in. lg			1	
-25	207104-021	.	.	WASHER, Flat, No. 10			3	
-26	205042-600	.	.	PIN, Clevis, 3/16 x 1/2 in. lg			1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-2				
-27	961019-001 961018-001 961020-001 961017-001	. PRINTED WIRING BOARD ASSEMBLY, Drive formatter (See Figure 5-6 for breakdown)	| | | |	A B C D
		(ATTACHING PARTS)		
-28	213274-606	. SCREW, Pan head, phillips, 6-32 x 3/8 in. lg	|	
-29	207602-011	. WASHER, Split lock, No. 6 .....	|	
-30	207605-021	. WASHER, Flat, No. 6 .....	|	
		--- * ---		
-31	211151-330	. FUSE, 3AG, slo-blo, 3 amp .....	|	
-32	160106-409	. HARNESS ASSEMBLY (See Figure 5-7 for breakdown)	|	
-33	160105-453	. HARNESS ASSEMBLY, Power switch .....	|	
-34	760105-518	. LANYARD, Elastic .....	|	
-35	760105-519	. PIN, Safety .....	|	

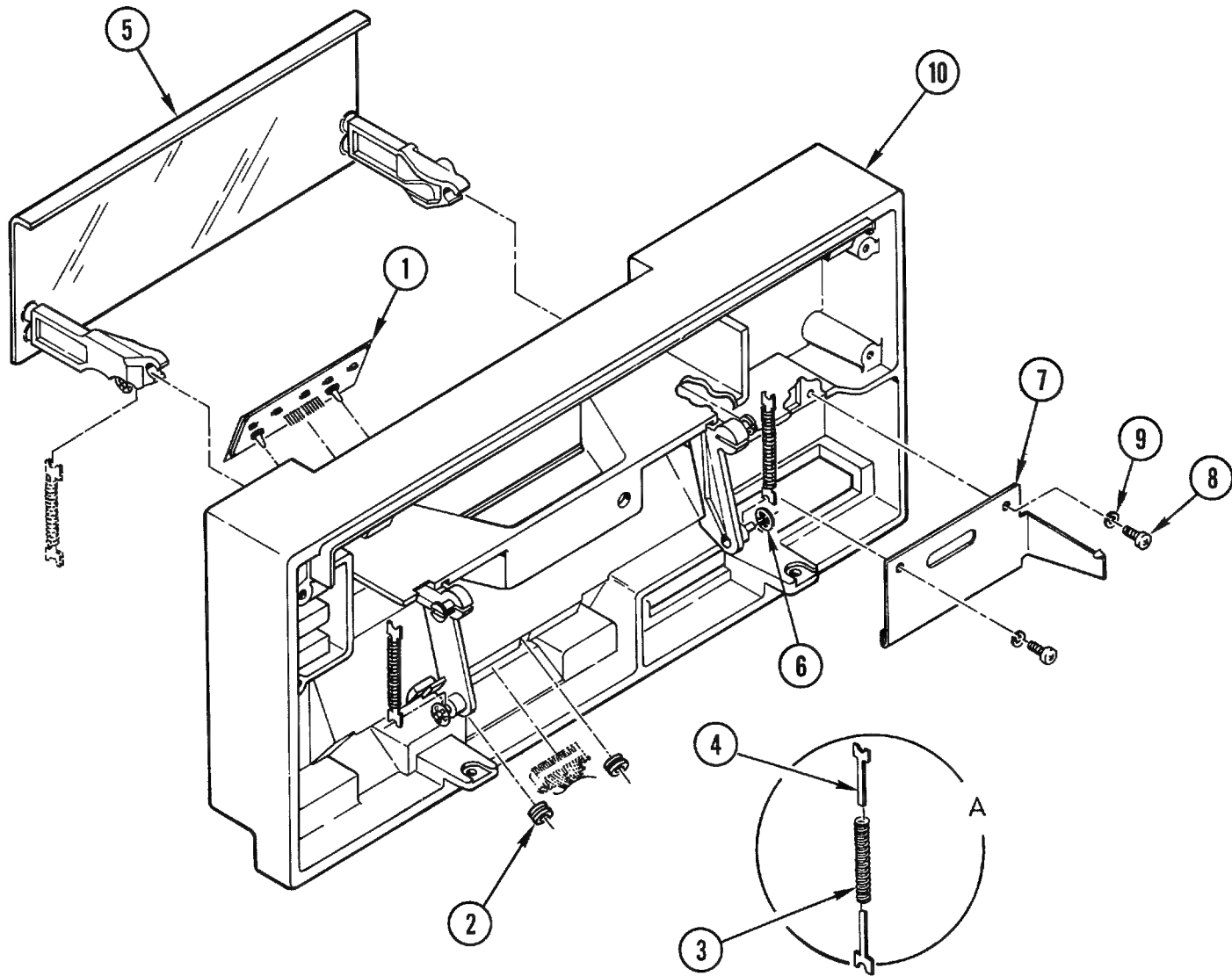


Figure 5-3. Front Panel Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-3	960359-001	FRONT PANEL ASSEMBLY (See Figure 5-2 for next higher assembly)	REF	
-1	760102-595	. TOUCH SWITCH, Tactile response.....	1	
-2	210200-016	. RING, Retaining, push-on	2	
-3	210001-013	. SPRING, Compression, 5-lb.....	2	
-4	760101-591	. GUIDE, Spring	4	
-5	160101-451	. DOOR ASSEMBLY	1	
-6	210200-016	. RING, Retaining, push-on	2	
-7	760101-531	. LATCH, Rack	1	
		(ATTACHING PARTS)		
-8	213271-606	. SCREW, Pan head, phillips, 6-32 x 3/8 in. lg., cadmium plated, black, zinc	2	
-9	207602-011	. WASHER, Split lock, No. 6	2	
		--- * ---		
-10	760102-614	. FRONT PANEL, Painted	1	

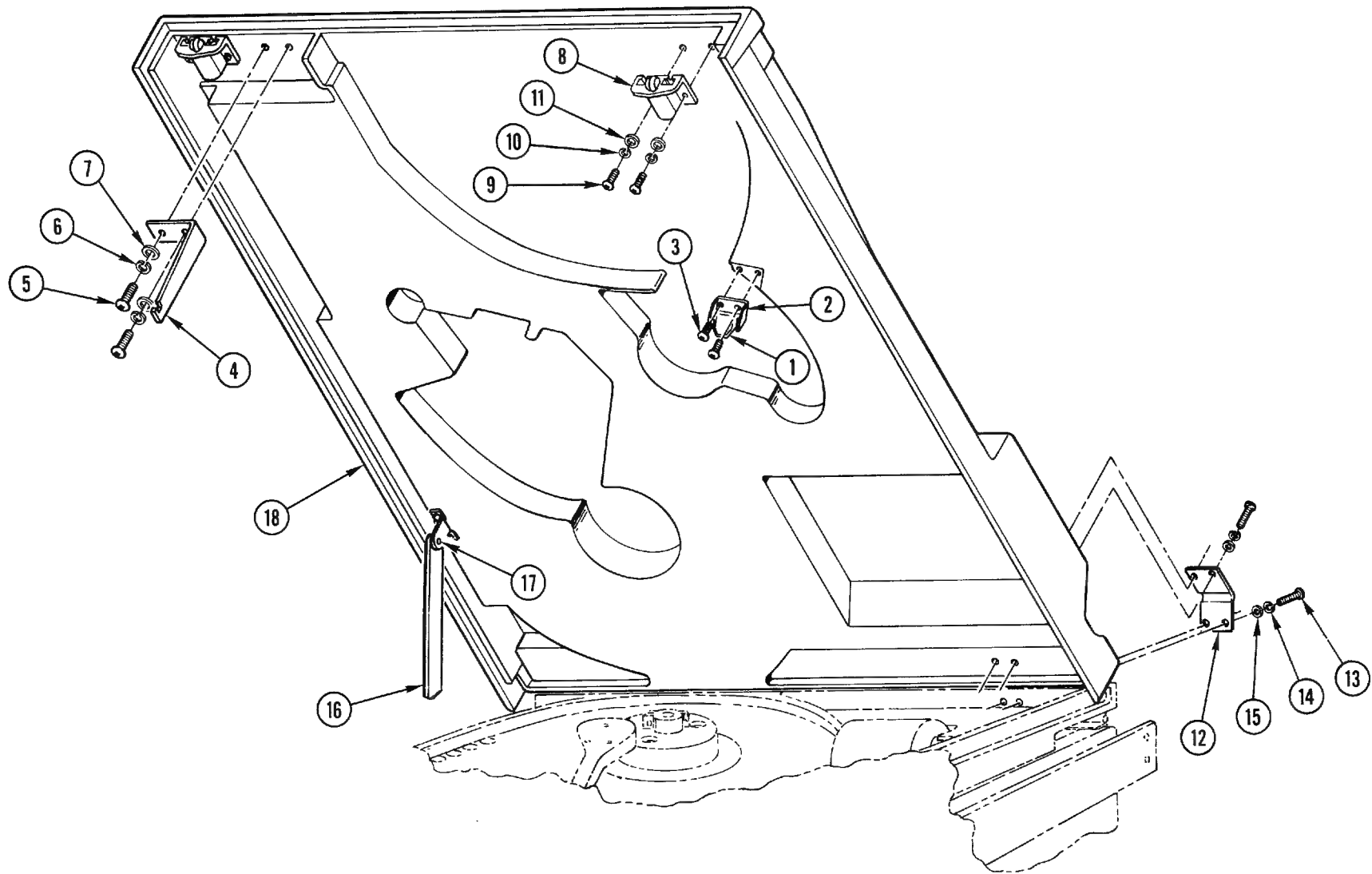


Figure 5-4. Top Cover Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-4	960057-001	TOP COVER ASSEMBLY (See Figure 5-2 for next higher assembly)	REF	
-1	760101-825	. DEFLECTOR TAPE, diecast	1	
-2	760102-585	. BRACKET, Tape deflector	1	
		(ATTACHING PARTS)		
-3	213271-404	. SCREW, Pan head, phillips, 4-40 x 1/4 in. lg	2	
		--- * ---		
-4	760101-580	. . TAB, Cover lock	1	
		(ATTACHING PARTS)		
-5	213271-604	. . SCREW, Pan head, phillips..... 6-32 x 1/4 in. lg, cadmium, black, zinc	2	
-6	207602-011	. . WASHER, Split lock, No. 6	2	
-7	207608-021	. . WASHER, Flat, No. 6	1	
		--- * ---		
-8	210104-911	. . CATCH, Roller	2	
		(ATTACHING PARTS)		
-9	213271-406	. . SCREW, Pan head, phillips..... 4-40 x 3/8 in. lg, cadmium, black, zinc	4	
-10	207403-011	. . WASHER, Split lock, No. 4	4	
-11	207402-021	. . WASHER, Flat, No. 4	4	
		--- * ---		
-12	760103-507	. HINGE, Rear, molded	2	
		(ATTACHING PARTS)		
-13	213274-605	. SCREW, Pan head, phillips..... 6-32 x 5/16 in. lg	4	
-14	207602-011	. WASHER, Split lock, No. 6	4	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-4				
-15	207608-021	. WASHER, Flat, small OD, No. 6 *	4	
-16	960052-001	. . LID STAY, Relieved (ATTACHING PARTS)	1	
-17	205003-005	. . PIN, Groove, 0.1875 x 0.625 in. lg *	1	
-18	760104-502	. . TOP COVER.....	1	

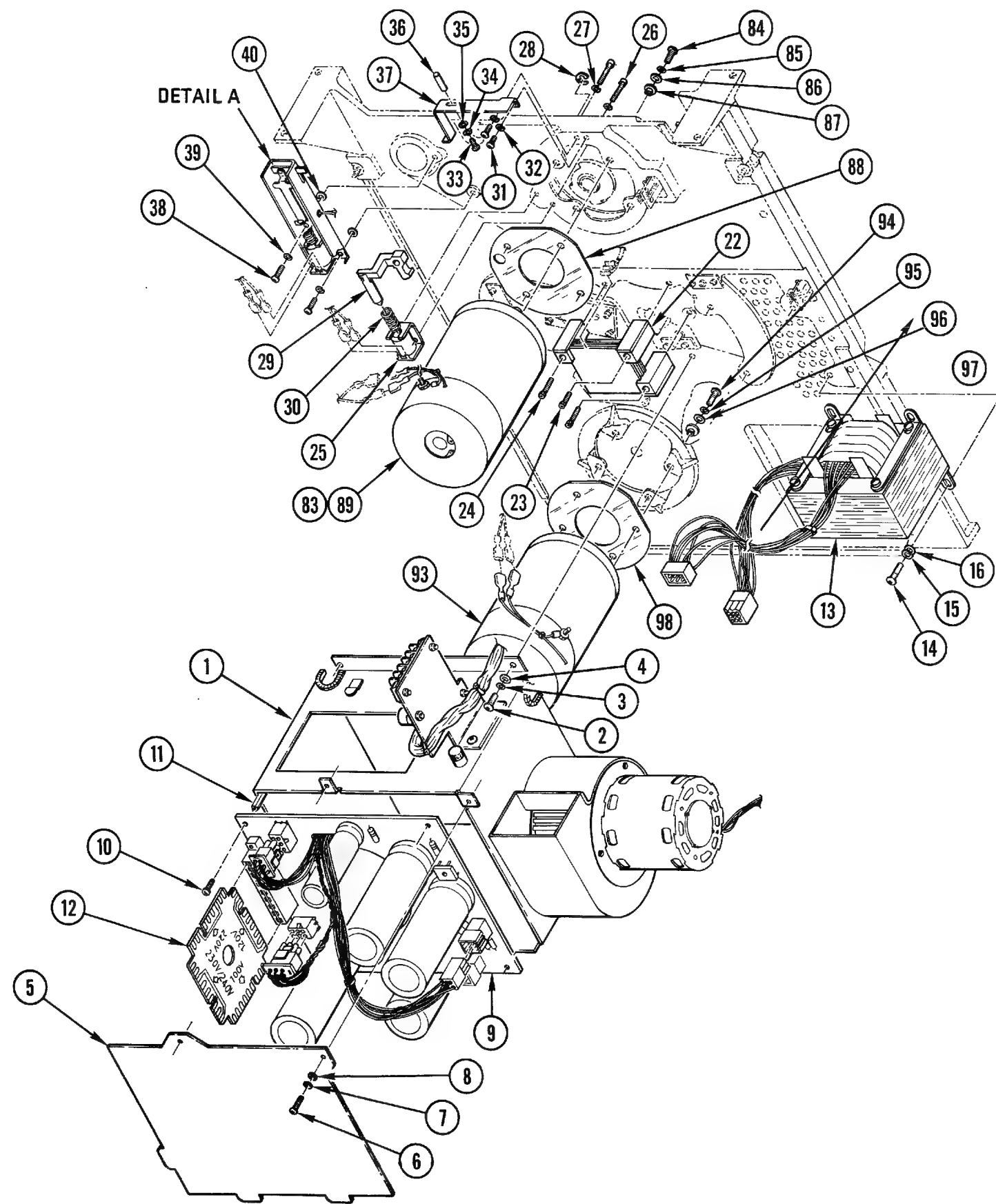


Figure 5-5. Top Plate/Chassis Assembly (Exploded View)

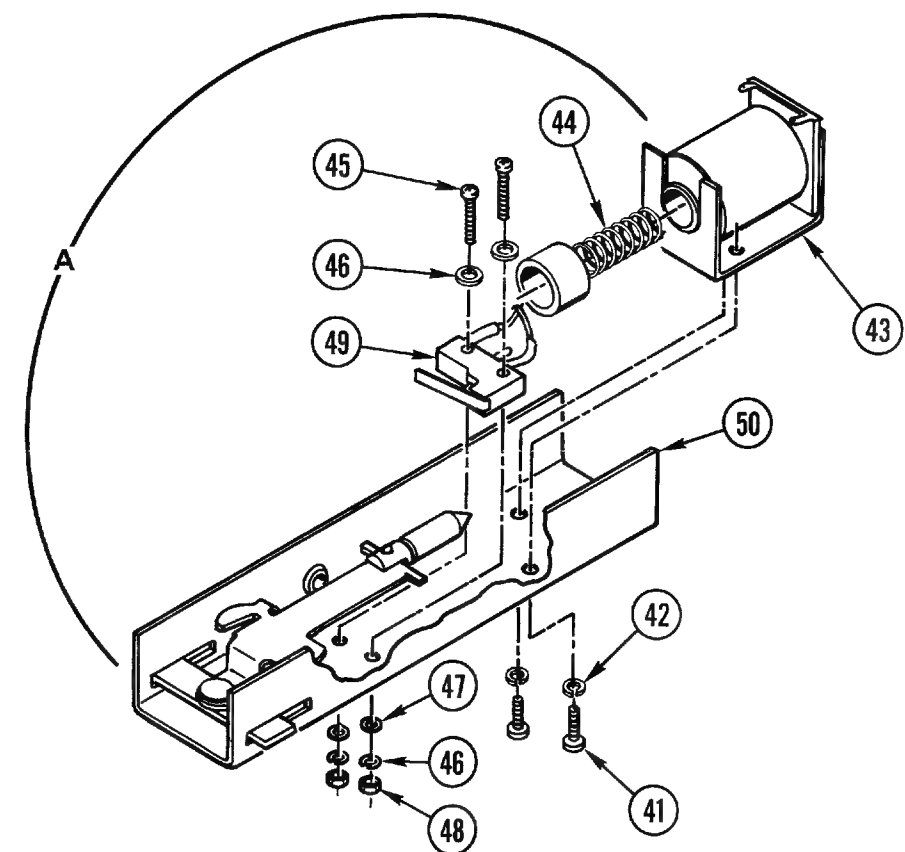


Figure 5-5
Sheet 1 of 4

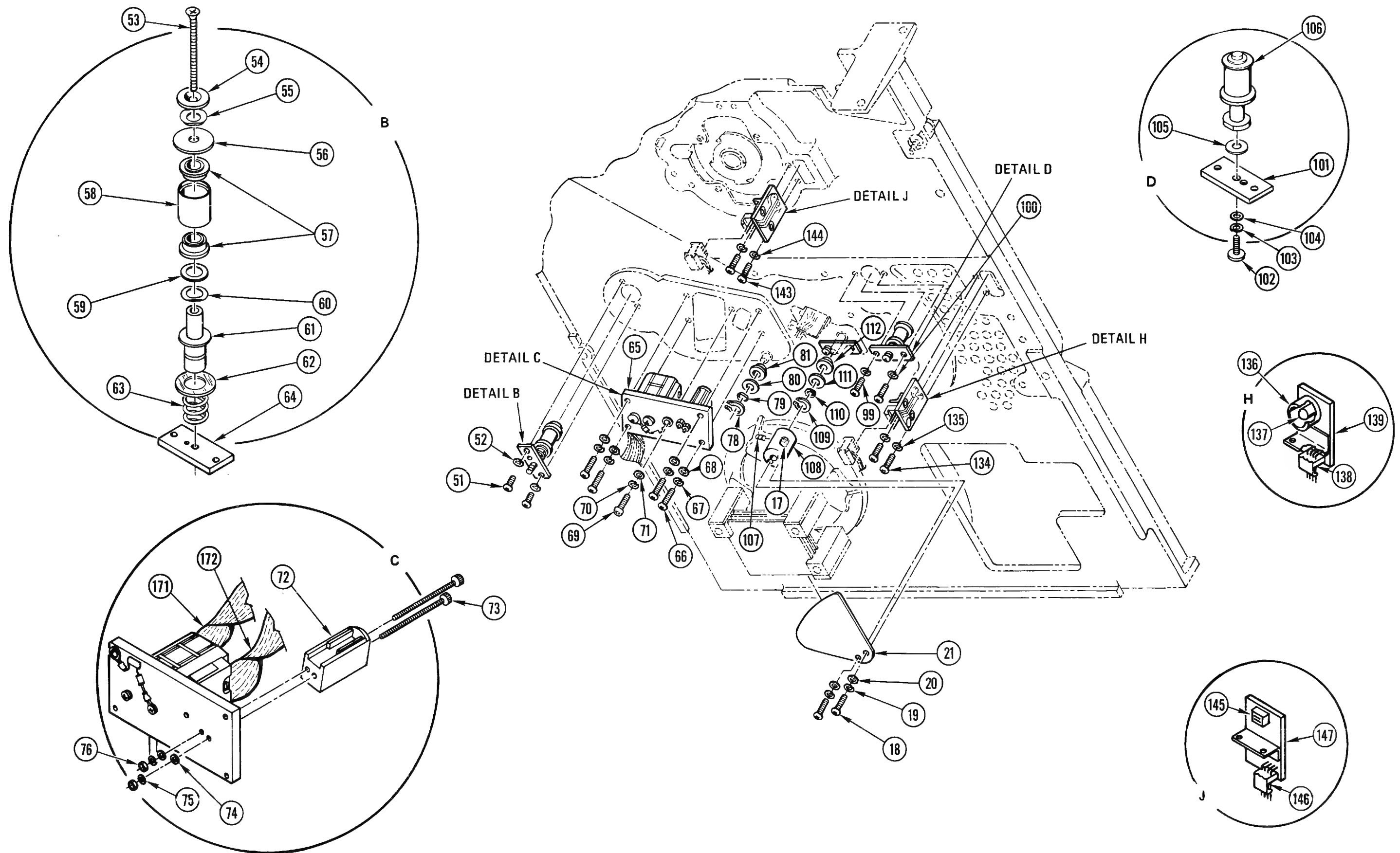


Figure 5-5. Top Plate/Chassis Assembly (Exploded View)

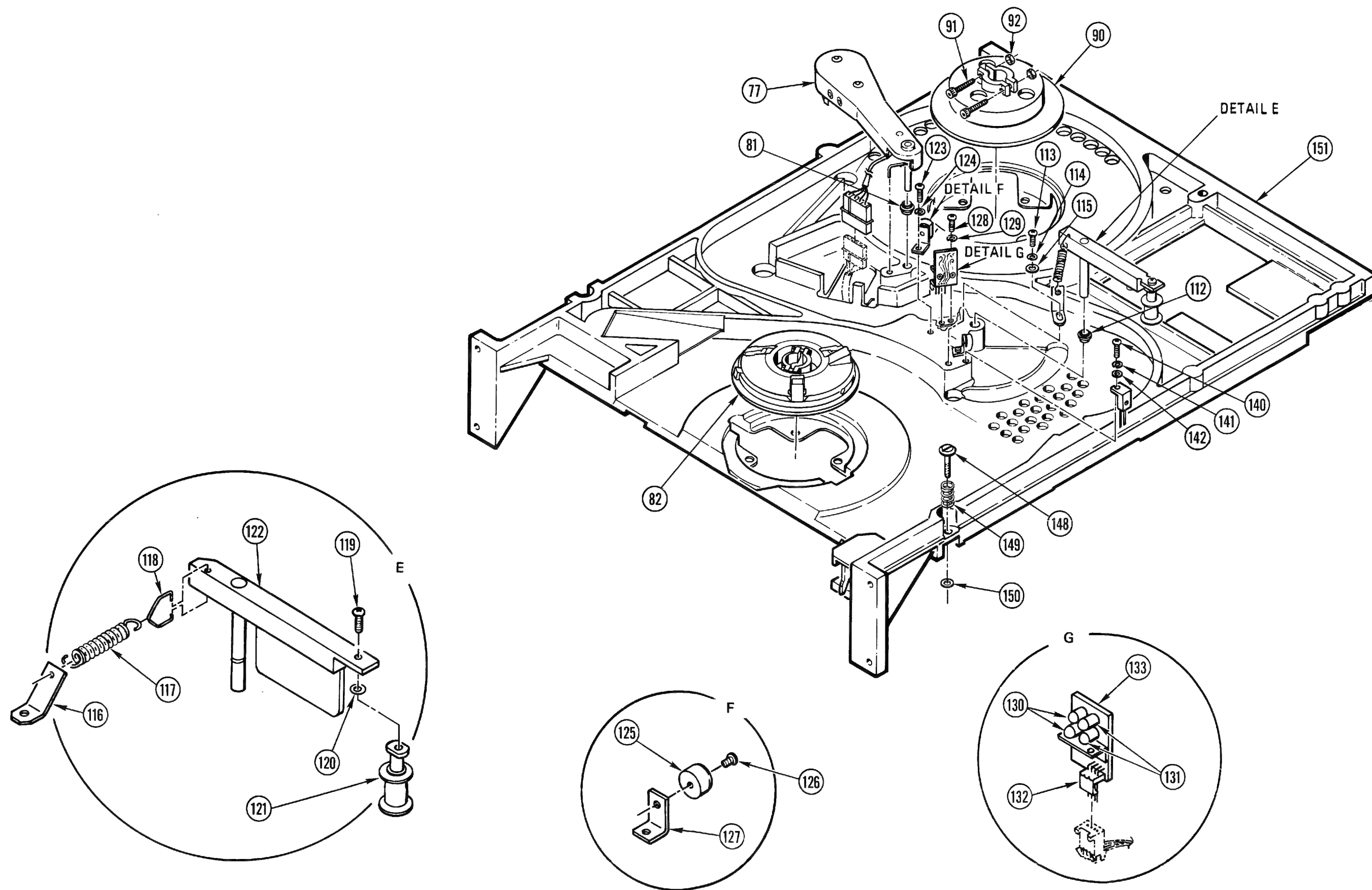


Figure 5-5. Top Plate/Chassis Assembly (Exploded View)

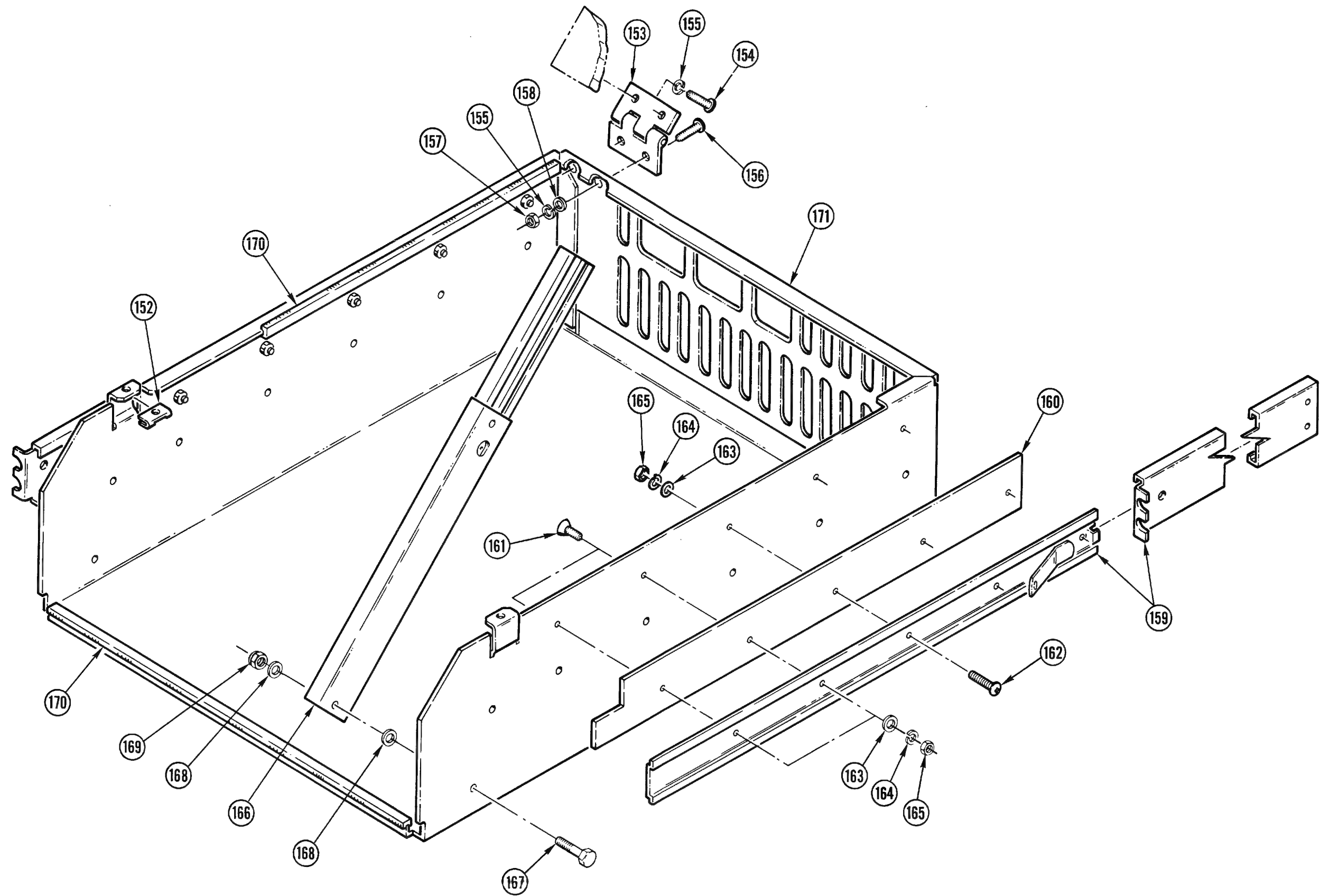


Figure 5-5. Top Plate/Chassis Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5	960567-001	TOP PLATE/CHASSIS ASSEMBLY (See Figure 5-2 for next higher assembly)	REF	
-1	960292-001	. POWER SUPPLY HOUSING ASSEMBLY (See Figure 5-8 for breakdown) (ATTACHING PARTS)	1	
-2	213091-106	. SCREW, Socket head, cap, 10-32 x 3/8 in. lg, cadmium plated, black, zinc	4	
-3	207102-011	. WASHER, Split lock, No. 10	4	
-4	207104-021	. WASHER, Flat, No. 10	4	
		--- * ---		
-5	960015-001	. COVER ASSEMBLY, Power supply housing (ATTACHING PARTS)	1	
-6	213271-605	. SCREW, Pan head, phillips 6-32 x 5/16 in. lg, cadmium, black zinc	2	
-7	207602-011	. WASHER, Split lock, No. 6	2	
-8	207605-021	. WASHER, Flat, No. 6	2	
		--- * ---		
-9	960298-001	. PWB ASSEMBLY, Power Supply	1	
		(ATTACHING PARTS)		
-10	213621-606	. SCREW, Socket set, knurled cup pt, 6-32 x 3/8, cadmium, black, zinc	4	
-11	210030-250	. STANDOFF, 1/4 Hex, 1, 6-32	4	
		--- * ---		
-12	760102-102	. PWB VOLTAGE SELECT	1	
-13	160106-402	. TRANSFORMER ASSEMBLY	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5		(ATTACHING PARTS)		
-14	213271-106	. SCREW, Pan head, phillips, 10-32 x 3/8 in. lg, cadmium plated, black, zinc	4	
-15	207102-011	. WASHER, Split lock, No. 10	4	
-16	207104-021	. WASHER, Flat, No. 10	4	
		--- * ---		
	960703-001	. CAPACITOR SHUTTER ASSEMBLY	1	
		(ATTACHING PARTS)		
-17	213092-608	. SOCKET HEAD, cap, 6-32 x 1/2 in. lg. black	1	
-18	207606-031	. WASHER, Internal lock, No. 6	1	
-19	207607-051	. NUT, Hex, No. 6	1	
-20	213921-405	. SCREW, Pan head, phillips, 4-40 x 7/16 in. lg, cadmium, black, zinc	2	
-21	207403-011	. WASHER, Split lock, No. 4	2	
-22	207408-021	. WASHER, Flat, small OD, No. 4	2	
		--- * ---		
-23	760102-575	. SHUTTER, Molded	1	
-24	160101-471	. CAPACITOR PLATE ASSEMBLY	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5		(ATTACHING PARTS)		
-25	213091-408	. SCREW, Socket head, cap 4-40 x 1/2 in. lg, cadmium, black zinc	1	
-26	213091-410	. SCREW, Socket head, cap 4-40 x 5/8 in. lg, cadmium, black zinc	2	
		----- * -----		
-27	760101-840	. SOLENOID, 24 Vdc continuous	1	
		(ATTACHING PARTS)		
-28	213092-612	. SCREW, Socket head, cap 6-32 x 3/4 in. lg, black	2	
-29	207602-011	. WASHER, Split lock, No. 6	2	
-30	210200-001	. RING, Retaining	1	
		----- * -----		
-31	760106-510	. BELLCRANK, Reel hub lock	1	
-32	760101-704	. SPRING, Compression	1	
	160101-417	. MANUAL UNLOCK ASSEMBLY	1	
		(ATTACHING PARTS)		
-33	213274-404	. SCREW, Pan head, phillips, 4-40 x 1/4 in. lg, cadmium plated, black, zinc	2	
-34	207403-011	. WASHER, Split lock, No. 4	2	
		----- * -----		
-35	213274-404	. . SCREW, Pan head, phillips, 4-40 x 1/4 in. lg, cadmium plated, black, zinc	1	
-36	207403-011	. . WASHER, Split lock, No. 4	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-37	207402-021	. . WASHER, Flat, No. 4	1	
-38	760101-629	. . PIN, Reel hub unlock	1	
-39	760101-622	. . BRACKET, Spring, reel hub unlock	1	
	160105-432	. DOOR LOCK ASSEMBLY	1	
		(ATTACHING PARTS)		
-40	213271-607	. SCREW, Pan head, phillips..... 6-32 x 7/16 in. lg, cadmium plated, black, zinc	2	
-41	207602-011	. WASHER, Split lock, No. 6	2	
-42	207605-021	. WASHER, Flat, No. 6	2	
		--- * ---		
-43	213271-603	. . SCREW, Pan head, phillips..... 6-32 x 3/16 in. lg, cadmium plated, black, zinc	2	
-44	207602-011	. . WASHER, Split lock, No. 6	2	
-45	760101-840	. . SOLENOID, Coil	1	
-46	760101-704	. . SPRING, Compression	1	
-47	213271-208	. . SCREW, Pan head, phillips..... 2/56 x 1/2, in. lg, cadmium plated black, zinc	2	
-48	207202-021	. . WASHER, Flat, No. 2	4	
-49	207206-011	. . WASHER, Split lock, No. 2	2	
-50	207205-051	. . NUT, Hex, 2-56, No. 2	2	
-51	211015-011	. . SWITCH, Lever, quick disconnect.....	1	
-52	760101-579	. . BRACKET, Door lock.....	1	
	160104-400	. ROLLER GUIDE ASSEMBLY.....	3	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5		(ATTACHING PARTS)		
-53	213271-407	. SCREW, Pan head, phillips, 4-40 x 7/16 in. lg, cadmium plated, black, zinc	3	
-54	207403-011	. WASHER, Split lock, No. 6 -- -- -- * -- -- --	3	
-55	213151-424	. . SCREW, Fillister head, phillips 100 4 x 40 x 1-1/2 in. lg.	1	
-56	754004-901	. . CAP, Roller guide	1	
-57	210260-000	. . WASHER, Spring, crescent	1	
-58	754007-901	. . WASHER, Guide	1	
-59	210067-001	. . BEARING, 1/4 x 3/8 in.	2	
-60	760101-540	. . ROLLER, Spring guide	1	
-61	731911-101	. . SHIM, .004 thick, 1/4 in. ID	1	
	731911-102	. . SHIM, .005 thick, 1/4 in. ID	1	
	731911-105	. . SHIM, .010 thick, 1/4 in. ID	1	
-62	210008	. . WASHER, Wave spring	1	
-63	760101-833	. . BASE, Roller guide	1	
-64	754007-801	. . WASHER, Guide	1	
-65	210003-038	. . SPRING, Compression	1	
-66	760101-567	. . PLATE, Tape guide	1	
-67	960870-001	. HEAD ASSEMBLY.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5		(ATTACHING PARTS)		
-68	213271-408	. SCREW, Pan head, phillips..... 4-40 x 1/2 in. lg, cadmium plated black, zinc	4	
-69	207403-011	. WASHER, Split lock, No. 4	4	
-70	207402-021	. WASHER, Flat, No. 4	4	
-71	213092-408	. SCREW, Socket head, cap,..... 4-40 x 1/2, black	1	
-72	207403-011	. WASHER, Split lock, No. 4	1	
-73	207402-021	. WASHER, Flat, No.4..... -- -- -- * -- -- --	1	
-74	131047-003	. . TAPE SCRAPER ASSEMBLY	1	
		(ATTACHING PARTS)		
-75	213091-407	. . SCREW, Socket head, cap,.....	2	
-76	207408-021	. . WASHER, Flat, small OD, No. 4	2	
-77	207403-011	. . WASHER, Split lock, No 4	2	
-78	207406-081	. . NUT, Hex, radio pattern, No. 4, 4-40.....	2	
		-- -- -- * -- -- --		
-79	160105-433	. TACHOMETER ASSEMBLY.....	1	
		(ATTACHING PARTS)		
-80	210200-032	. RING, Grip, 1/4 in. ID	1	
-81	210008	. WASHER, Wave spring	1	
-82	731911-102	. SHIM, .005 in. thick, 1/4 in. ID	AR	
-83	210067-001	. BEARING, 1/4 x 3/8 in.	2	
		-- -- -- * -- -- --		

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-84	160101-406	. SUPPLY HUB ASSEMBLY (See Figure 5-9 for breakdown)	1	
-85	160101-497	. SUPPLY MOTOR ASSEMBLY (ATTACHING PARTS)	1	
-86	213271-107	. SCREW, Pan head, phillips, 10-32 x 7/16 in. lg, cadmium plated, black, zinc	4	
-87	207102-011	. WASHER, Split lock, No. 10	4	
-88	213704-100	. WASHER, Flat, No. 10	4	
-89	760101-768	. WASHER, Shoulder, insulating -- -- -- * -- -- --	4	
-90	760101-756	. INSULATOR, Motor	1	
-91	760101-527	. MOTOR, Permanent magnet, 4 in. diameter, supply	1	
-92	760106-567	. HUB, Takeup (ATTACHING PARTS)	1	
-93	213091-614	. SCREW, Socket head cap, 6-32 x 7/8 in. lg	2	
-94	207607-051	. NUT, Hex, 6-32, No. 6 -- -- -- * -- -- --	2	
-95	799031-201	. MOTOR, Permanent magnet, 4 in. dia, takeup (ATTACHING PARTS)	1	
-96	213271-107	. SCREW, Pan head, phillips, 10-32 x 7/16 in. lg, cadmium plated, black, zinc	4	
-97	207102-011	. WASHER, Split lock, No. 10	4	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-98	213704-100	. WASHER, Flat, No. 10	4	
		--- * ---		
-99	760101-768	. WASHER, Shoulder, insulating	4	
-100	760101-756	. INSULATOR, Motor	1	
	160104-401	. ROLLER GUIDE ASSEMBLY.....	1	
		(ATTACHING PARTS)		
-101	213271-406	. SCREW, Pan head, phillips, 4-40 x 3/8 in. lg, cadmium, black, zinc	2	
-102	207403-011	. WASHER, Split lock, No. 4	2	
-103	760101-566	. . PLATE, Tape guide	1	
-104	213274-605	. . SCREW, Pan head, phillips, 6-32 x 5/16 in. lg	1	
-105	207602-011	. . WASHER, Split lock, No. 6	1	
-106	207605-021	. . WASHER, Flat, No. 6	1	
		--- * ---		
-107	760104-524	. . SHIM, Stainless steel	1	
-108	799043-201	. . ROLLER, Tape guide	1	
	160103-499	. COMPLIANCE ARM ASSEMBLY	1	
		(ATTACHING PARTS)		
-109	960712-001	. HUB, Capacitor shutter	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-5								
-110	210200-032	.	RING, Retaining, external, 1/4 in.				1	
-111	210008	.	WASHER, Wave spring				1	
-112	731911-102	.	SHIM, 0.005 in. thick x 1/4 in. ID				1	
-113	210067-001	.	BEARING, 1/4 x 3/8 in.				2	
-114	213271-606	.	SCREW, Pan head, phillips..... 6-32 x 3/8 in. lg, cadmium, black, zinc				1	
-115	207602-011	.	WASHER, Split lock, No. 6				1	
-116	207605-021	.	WASHER, Flat, No. 6				1	
			--- * ---					
-117	760101-565	.	BRACKET, Spring, compliance arm.....				1	
-118	210006-010	.	SPRING, Extension				1	
-119	760101-554	.	CLIP, Spring.....				1	
-120	213271-607	.	SCREW, Pan head, phillips, 6-32 x 7/16 in. lg, cadmium, black, zinc				1	
-121	760104-524	.	SHIM, stainless steel.....				1	
-122	760104-500	.	TAPE GUIDE, Crowned roller, short				1	
-123	160104-492	.	ARM AND SHAFT ASSEMBLY				1	
	160106-479	.	BUMPER ASSEMBLY				1	
	160106-478	.	BUMPER ASSEMBLY				1	
			(ATTACHING PARTS)					
-124	213271-406	.	SCREW, Pan head, phillips, 4-40 x 3/8 in. lg, cadmium, black, zinc				2	
-125	207403-011	.	WASHER, Split lock, No. 4				2	
			--- * ---					

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-126	210119	. . BUMPER.....	2	
-127	213271-403	. . SCREW, Pan head, phillips, 4-40 x 3/16 in. lg, cadmium, black, zinc	2	
-128	760101-662	. . BRACKET, Compliance arm, stop	2	
	160101-009	. PRINTED WIRING BOARD ASSEMBLY, Reflective sensor, EOT/BOT	1	
		(ATTACHING PARTS)		
-129	213271-405	. SCREW, Pan head, phillips, 4-40 x 5/16 in. lg, cadmium, black, zinc	2	
-130	207403-011	. WASHER, Split lock, No. 4	2	
		--- * ---		
-131	202006-400	. . DIODE, Light emitting, IR.....	2	
-132	212000-012	. . PHOTOTRANSISTOR	2	
-133	211000-111	. . HEADER, 4-position, right angle	1	
-134	960062-101	. . PRINTED WIRING BOARD,..... Reflective sensor	1	
	160101-010	. PRINTED WIRING BOARD ASSEMBLY, Reflective sensor, Tape-In-Path	1	
		(ATTACHING PARTS)		
-135	213271-406	. SCREW, Pan head, phillips, 4-40 x 3/8 in. lg, cadmium, black, zinc	2	
-136	207403-011	. WASHER, Split lock, No. 4	2	
		--- * ---		
-137	760101-812	. . SHIELD, Reflective sensor	1	
-138	202006-400	. . DIODE, Light emitting, IR.....	1	
-139	211000-111	. . HEADER, 4-position, right angle	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-5								
-140	960062-101	.	.	PRINTED WIRING BOARD,.....		Reflective sensor	1	
	160103-433	.	.	SENSOR RECEIVER ASSEMBLY, Molded			1	
				(ATTACHING PARTS)				
-141	213271-406	.		SCREW, Pan head, phillips,		4-40 x 3/8 in. lg, cadmium, black, zinc	1	
-142	207403-011	.		WASHER, Split lock, No. 4			1	
-143	207402-021	.		WASHER, Flat, No. 4			1	
				--- * ---				
	160101-005	.		PRINTED WIRING BOARD ASSEMBLY,		File protect	1	
				(ATTACHING PARTS)				
-144	213217-406	.		SCREW, Pan head, phillips,		4-40 x 3/8 in. lg, cadmium, black, zinc	2	
-145	207403-011	.		WASHER, Split lock, No. 4			2	
				--- * ---				
-146	211131-101	.	.	SENSOR, Reflective object			1	
-147	211000-111	.	.	HEADER, 4-position, right angle			1	
-148	760101-105	.	.	PRINTED WIRING BOARD, File protect.....			1	
-149	213599-000	.		SCREW, Captive, quick opening			2	
-150	210004-006	.		SPRING, Compression, fastener			2	
-151	210116-026	.		FASTENER RETAINER			2	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-152	760106-547	. TOP PLATE	1	
-153	210116-027	. FASTENER, Clip-on	2	
-154	760103-535	. HINGE.....	2	
		(ATTACHING PARTS)		
-155	213271-107	. SCREW, Pan head, phillips..... 10-32 x 7/16 in. lg, cadmium black, zinc	4	
-156	207102-011	. WASHER, Split lock, No. 10	8	
-157	213271-106	. SCREW, Pan head, phillips,	4	
		10-32 x 3/8 in. lg, cadmium, black, zinc		
-158	207101-081	. NUT, Hex, radio pattern, No. 10.....	4	
-159	207104-021	. WASHER, Flat, No. 10	4	
		--- * ---		
-160	960274-001	. SLIDE ASSEMBLY, Modified	2	
		(ATTACHING PARTS)		
-161	213151-107	. SCREW, Flat head, phillips,..... 10-32 x 7/16 in. lg, cadmium, black or zinc	2	
-162	213271-106	. SCREW, Pan head, phillips..... 10-32 x 3/8 in. lg, cadmium black or zinc	6	
-163	207104-021	. WASHER, Flat, No. 10	8	
-164	207102-011	. WASHER, Split lock, No. 10	8	
-165	207101-081	. NUT, Hex, Radio pattern, No. 10, 10-32	8	
		--- * ---		
-166	160106-408	. SUPPORT ASSEMBLY, Top plate	1	

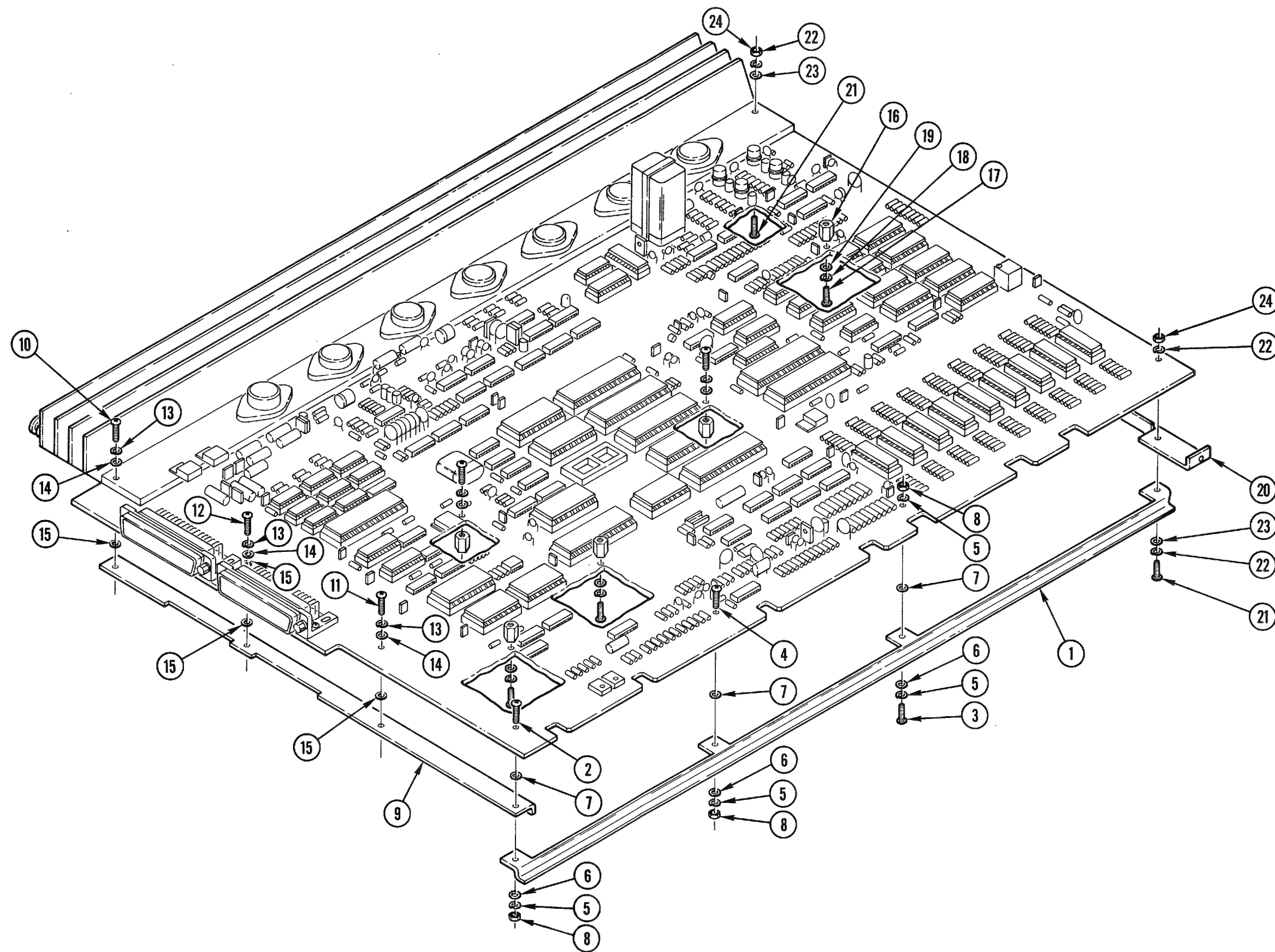


Figure 5-6. Drive Formatter Printed Wiring Board Assembly (Exploded View)

Figure 5-6

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-6	961019-001 961018-001 961020-001 961017-001	PRINTED WIRING BOARD ASSEMBLY, Drive..... formatter (See Figure 5-2 for next higher assembly and Figure 5-11 for breakdown)					REF	A B C D
-1	760101-695	. STIFFENER, Left side					1	
		(ATTACHING PARTS)						
-2	213271-607	. SCREW, Pan head, phillips..... 6-32 x 7/16 in. lg, cadmium, black, zinc					1	
-3	213020-608	. SCREW, BDR. hd. slot,..... 6-32 x 1/4 nylon					1	
-4	213271-607	. SCREW, Pan head, phillips..... 6-32 x 7/16 in. lg, cadmium, black, zinc					1	
-5	207602-011	. WASHER, Split lock, No. 6					4	
-6	207608-021	. WASHER, Flat, small OD, No. 6					3	
-7	213700-609	. WASHER, Flat, nylon, small OD, No. 6					3	
-8	207604-502	. NUT, Hex, radio pattern, 6-32					3	
		-- -- -- * -- -- --						
-9	760101-693	. STIFFENER, Rear					1	
		(ATTACHING PARTS)						
-10	213271-609	. SCREW, Pan head, phillips,					1	
		6-32 x 9/16 in. lg, cadmium black, zinc						
-11	213271-606	. SCREW, Pan head, phillips,					1	
		6-32 x 3/8 in. lg, cadmium, black, zinc						

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-6				
-12	213271-607	. SCREW, Pan head, phillips, 6-32 x 7/16 in. lg, cadmium, black, zinc	1	
-13	207602-011	. WASHER, Split lock, No. 6	3	
-14	207608-021	. WASHER, Flat, small OD, No. 6	3	
-15	213700-609	. WASHER, Flat, Nylon, small OD, No. 6..... -- -- -- * -- -- --	4	
-16	210030-632	. STANDOFF, 1/4 in. hex, A/F, 3/8 in., 6-32 (ATTACHING PARTS)	5	
-17	213274-606	. SCREW, Pan head, phillips..... 6-32 x 3/8 in. lg	5	
-18	207602-011	. WASHER, Split lock, No. 6	5	
-19	207608-021	. WASHER, Flat, small OD, No. 6	5	
		-- -- -- * -- -- --		
-20	760102-543	. STIFFENER, Front	1	
		(ATTACHING PARTS)		
-21	213271-608	. SCREW, Pan head, phillips, 6-32 x 1/2 in. lg, cadmium, black, zinc	2	
-22	207602-011	. WASHER, Split lock, No. 6	3	
-23	207608-021	. WASHER, Flat, small OD, No. 6	2	
-24	207604-081	. NUT, Hex, radio pattern, 6-32	2	
		-- -- -- * -- -- --		

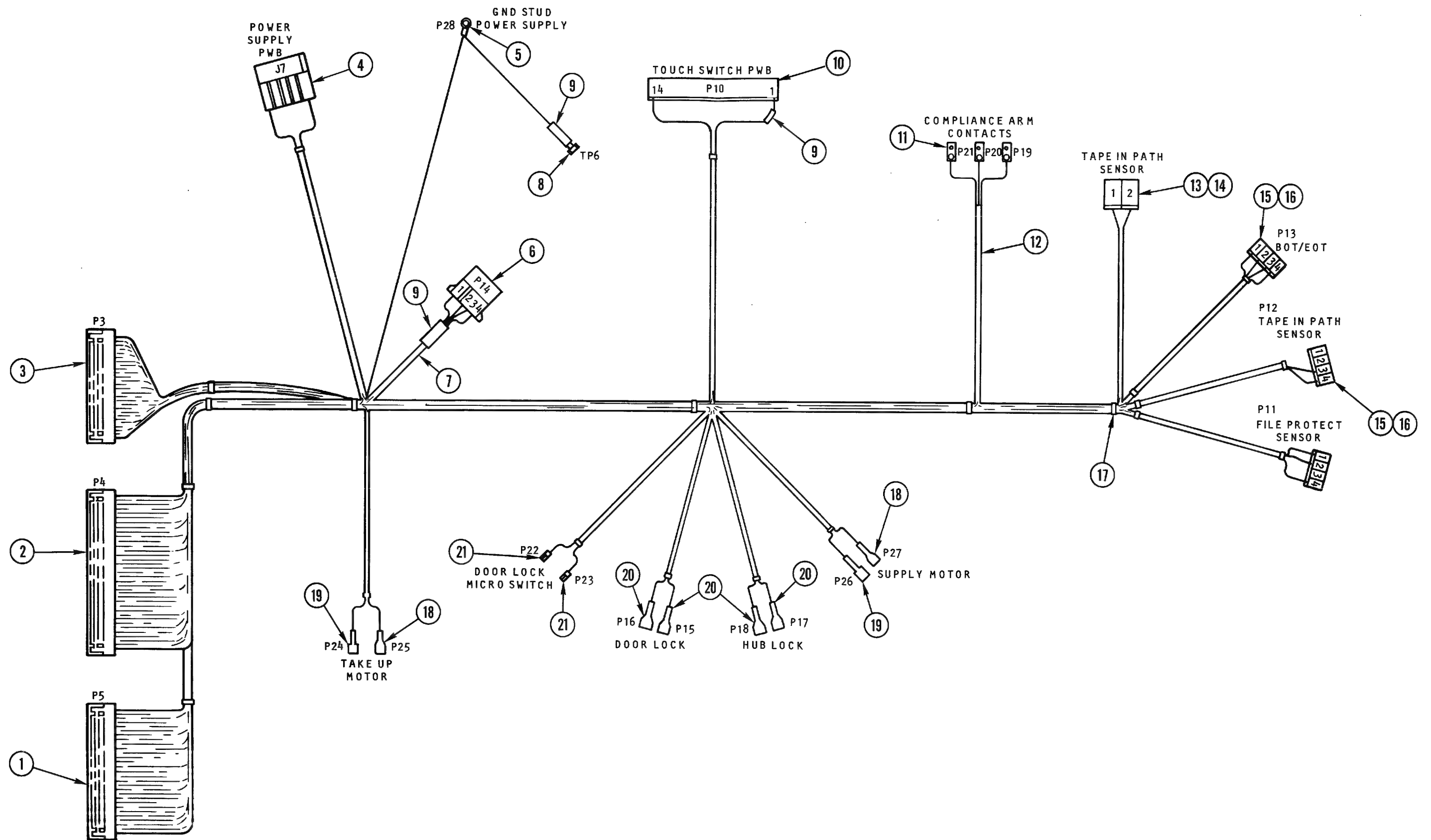


Figure 5-7. Harness Assembly

Figure 5-7

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-7	960629-001	HARNESS ASSEMBLY (See Figure 5-2 for next higher assembly)	REF	
-1	205108-118	. CONNECTOR, Printed circuit, right angle, 18-pin, without flanges	1	
-2	205108-122	. CONNECTOR, Printed circuit, right angle, 22-pin, without flanges	1	
-3	205108-115	. CONNECTOR, Printed circuit, right angle, 15-pin, without flanges	1	
-4	205071-500	. CONNECTOR, 15-position.....	1	
-5	210905	. LUG, Ring, No. 6.....	1	
-6	205107	. CONNECTOR, 4-position.....	1	
-7	208500-032	. CABLE, Shielded, 4-conductor, 24 AWG	AR	
-8	210575-611	. PIN, Receptacle, reel.....	1	
-9	210408-006	. TUBING, Heat shrink, black	AR	
-10	205124-108	. CONNECTOR, 14-position, ID	1	
-11	760101-729	. CONTACT, Capacitive plate.....	3	
-12	208500-041	. CABLE, Shielded, 2-conductor	2	
-13	205070-100	. CONNECTOR, 2-position, lock insulate	1	
-14	205089-002	. COVER, Connector, 2-position	1	
-15	205122-044	. CONNECTOR, 4-position, lock..... insulated, disp/plzd ramp	3	
-16	205089-001	. COVER, Connector, 4-position	3	
-17	210229-527	. TY-RAP, 1/32 in., 4 in. lg	32	
-18	210555-077	. TERMINAL, Nylon coupler, 22-18AWG	2	
-19	210555-078	. TERMINAL, 250x032 male, 22-18 gauge, fully insulated	2	
-20	210555-036	. TERMINAL, Slip-on, 0.187 tab, reel.....	4	
-21	210578-100	. TERMINAL, 0.093 tab, non-insulated.....	2	

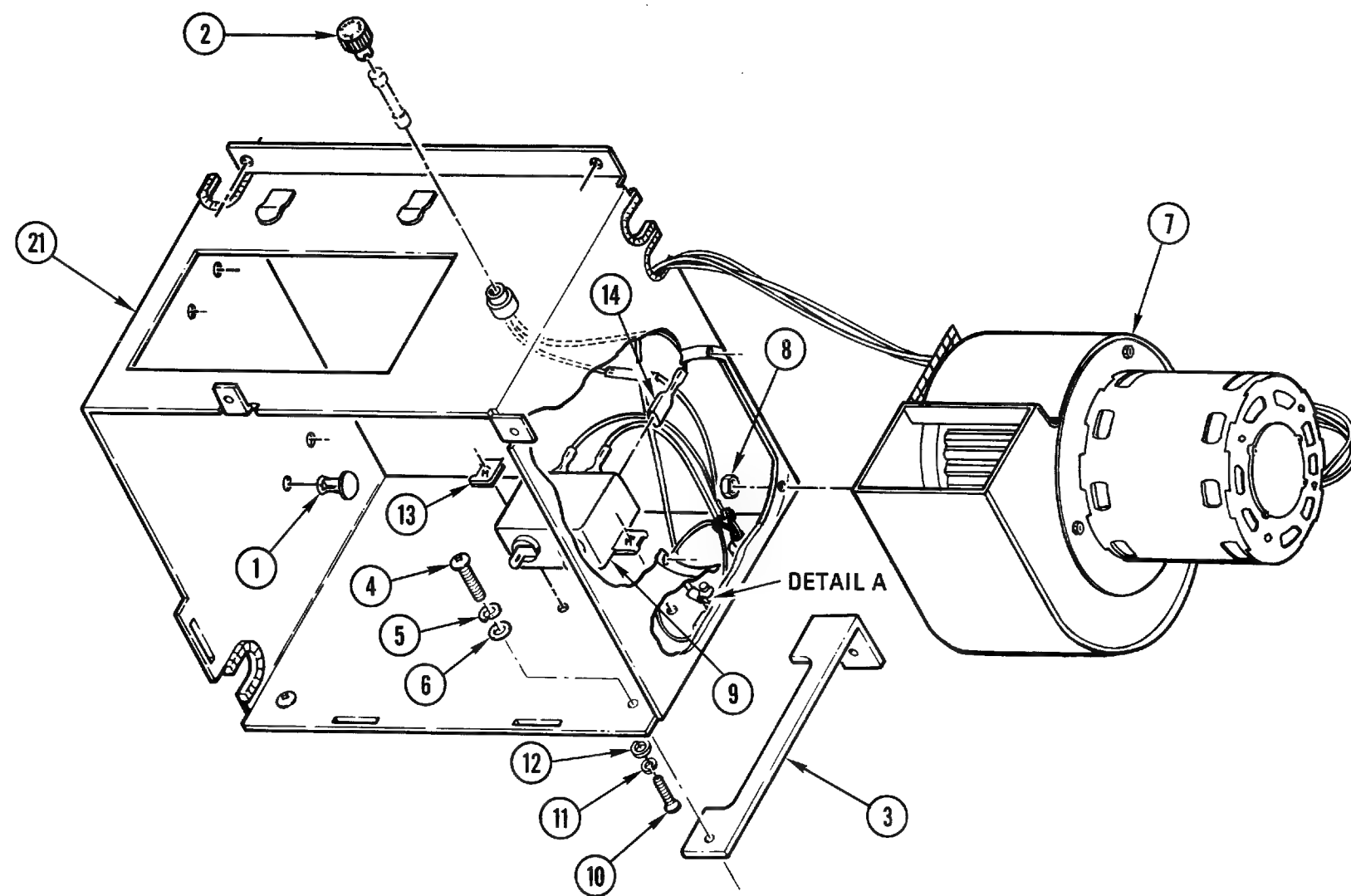


Figure 5-8. Power Supply Housing Assembly

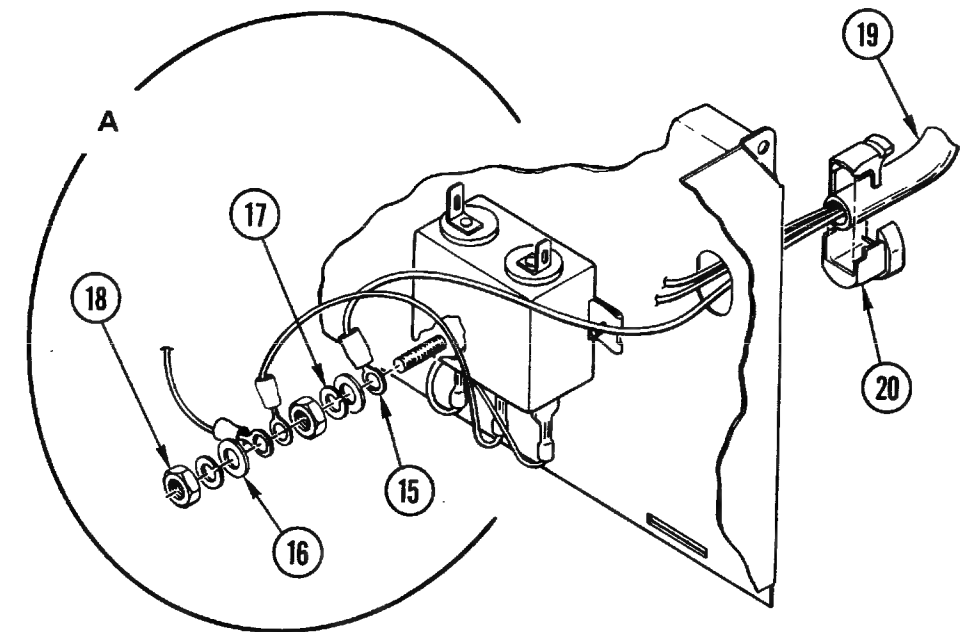


Figure 5-8

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-8	960292-001	HOUSING ASSEMBLY, Power Supply Assembly (See Figure 5-5 for next higher assembly)					REF	
-1	210229-005	.	CABLE TIE, Pushbutton mount				6	
-2	799016-401	.	FUSEHOLDER, Panel				1	
-3	760106-540	.	BRACKET				2	
			(ATTACHING PARTS)					
-4	213092-106	.	SCREW, Socket head cap 10-32 x 3/8 in lg, black only				2	
-5	207102-011	.	WASHER, Split lock, No. 10				2	
-6	207104-021	.	WASHER, Flat, No. 10				2	
-7	160105-439	.	AIR PUMP ASSEMBLY				1	
			(ATTACHING PARTS)					
-8	207803-051	.	NUT, Hex, No. 8-32				3	
			--- * ---					
-9	960294-001	.	FILTER ASSEMBLY				1	
			(ATTACHING PARTS)					
-10	213271-606	.	SCREW, Pan head, phillips, 6-32 x 3/8 in lg, cadmium, black or zinc				2	
-11	207602-011	.	WASHER, Split lock, No. 6				2	
-12	207605-021	.	WASHER, Flat, No. 6				2	
-13	213898-609	.	NUT, 6-32, EH				2	
			--- * ---					
-14	210555-032	.	TERMINAL, Slip-on, 250 tab				3	
-15	210555-027	.	TERMINAL, Ring 22-16 AWG, No. 8				3	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-8								
-16	207801-021	.	WASHER, Flat, No. 8				2	
-17	207802-011	.	WASHER, Split lock, No. 8				2	
-18	207803-051	.	NUT, Hex, No. 8, 8-32				2	
-19	970035-005	.	POWER CORD ASSEMBLY, 6 ft lg.				1	
-20	960412-001	.	RECEPTACLE ASSEMBLY				1	
-21	960293-001	.	HOUSING, Power Supply				1	

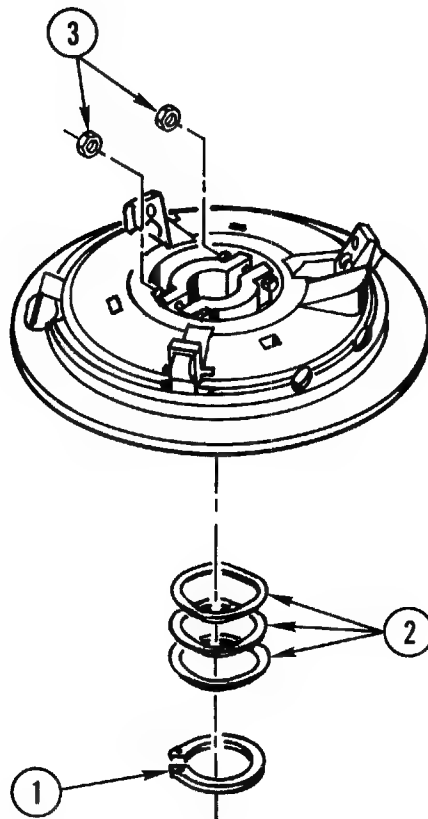


Figure 5-9. Supply Hub Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-9	160101-406	SUPPLY HUB ASSEMBLY (See Figure 5-5 for next higher assembly)	REF	
-1	210200-087	. RING, Retaining, external 7/8 in. ID	1	
-2	210009	. SPRING, Wave, No. 30 (ATTACHING PARTS)	3	
-3	207607-051	. NUT, Hex, No. 6 --- * ---	2	

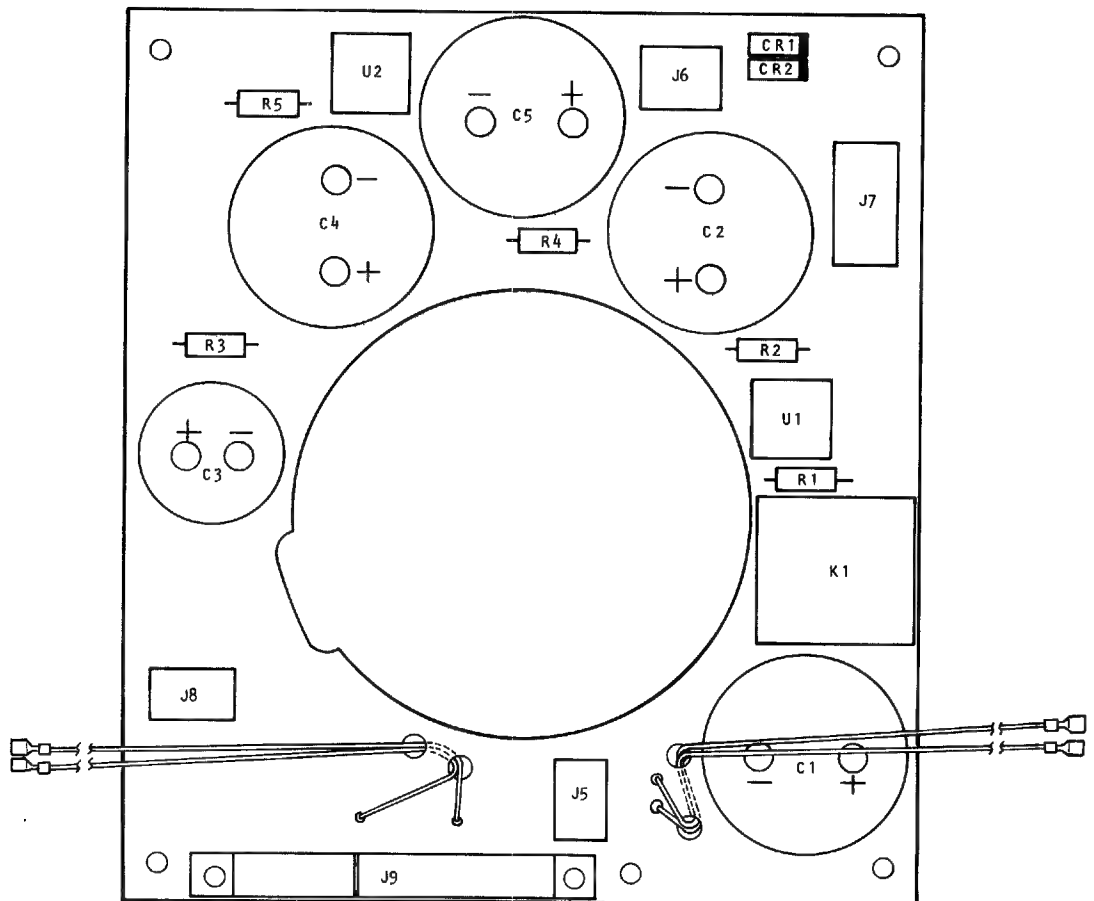
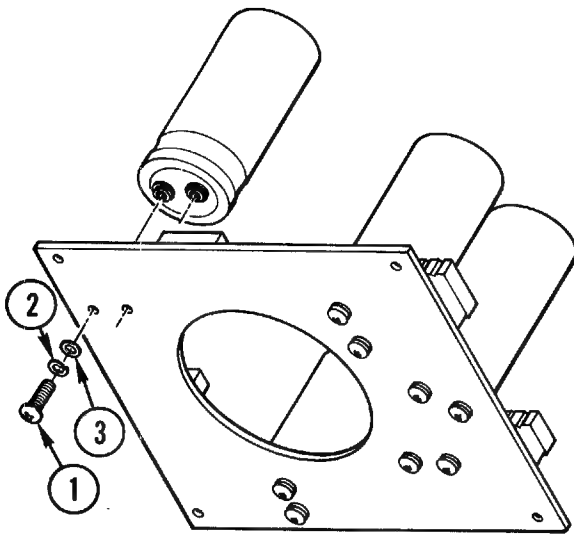


Figure 5-10. Power Supply Printed Wiring Board Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-10	960298-001	PRINTED WIRING BOARD ASSEMBLY. Power supply, (See Figure 5-8 for next higher assembly)					REF	
C1, C2	201174-250	.	CAPACITOR, Electrolytic, 25000uF,			30V	2	
C3	201174-160	.	CAPACITOR, Electrolytic, 16000uF,			15v	1	
C4, C5	201174-181	.	CAPACITOR, Electrolytic, 19000-.....			21000uF, 40 Vdc	2	
(ATTACHING PARTS)								
-1	213271-106	.	SCREW, Pan head, phillips.....			10-32 x 3/8 in. lg, cadmium black, zinc	10	
-2	207105-031	.	WASHER, Internal lock, No. 10.....				10	
-3	207108-021	.	WASHER, Flat, small OD, No. 4.....				10	
-- -- -- * -- -- --								
CR1, CR2	202009-751	.	DIODE, Rectifier, 6A, 12V				2	
J5	205195-200	.	CONNECTOR, Socket assembly,			6-position	1	
J6	205064	.	CONNECTOR, 9-position.....				1	
J7	205070	.	CONNECTOR HOUSING, 15-position				1	
J8	205195-300	.	CONNECTOR, Socket assembly			6-position	1	
J9	205108-023	.	CONNECTOR, Printed circuit			edge, 9-position	1	
K1	970098-001	.	RELAY, Opto isolated, printed circuit				1	
R1-5	200093-150	.	RESISTOR, FC, 1.5K, 1W, $\pm 5\%$				5	
U1, U2	799025-701	.	RECTIFIER BRIDGE, Printed circuit.....			mount	2	

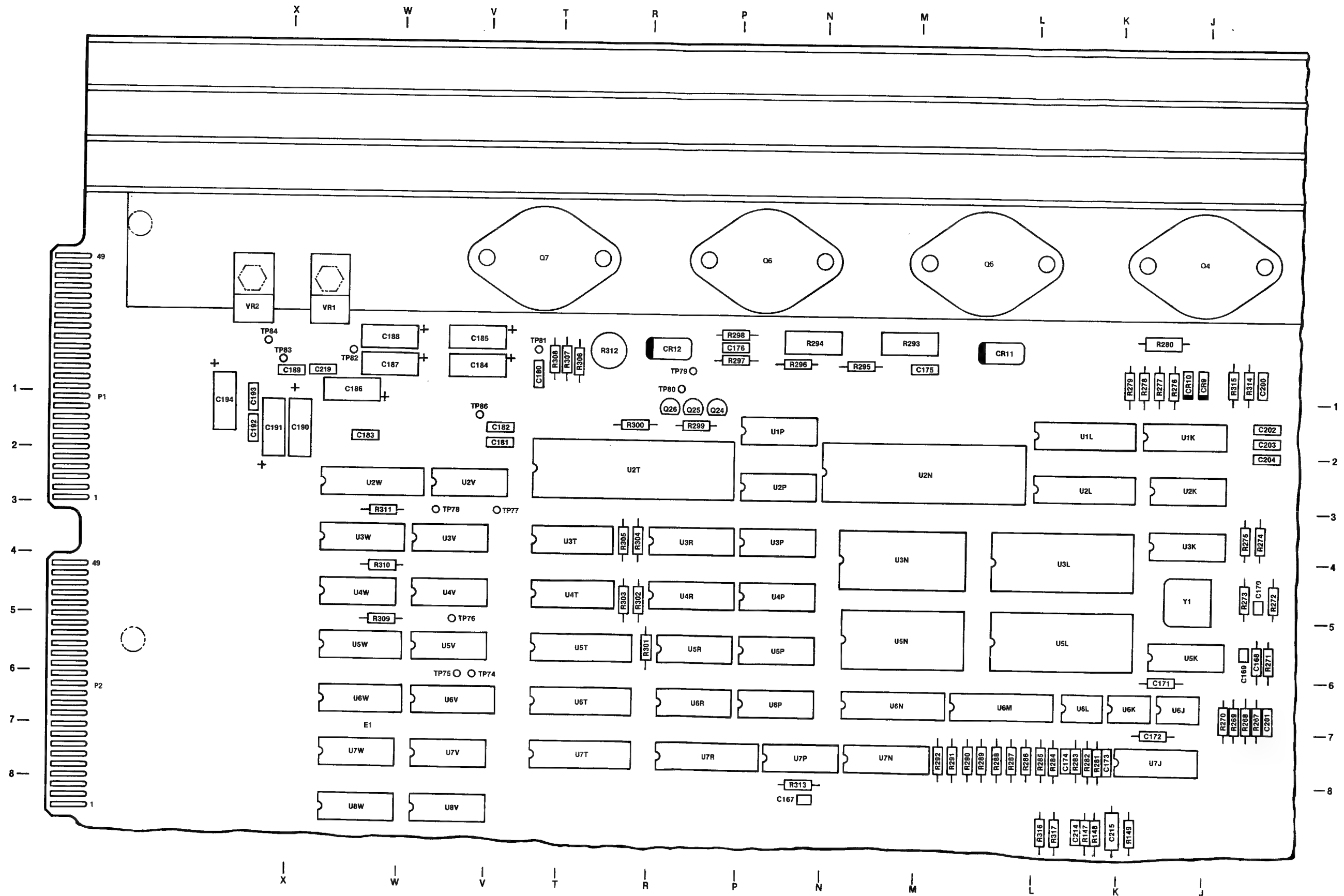


Figure 5-11. Drive Formatter PWB (Orthographic View)

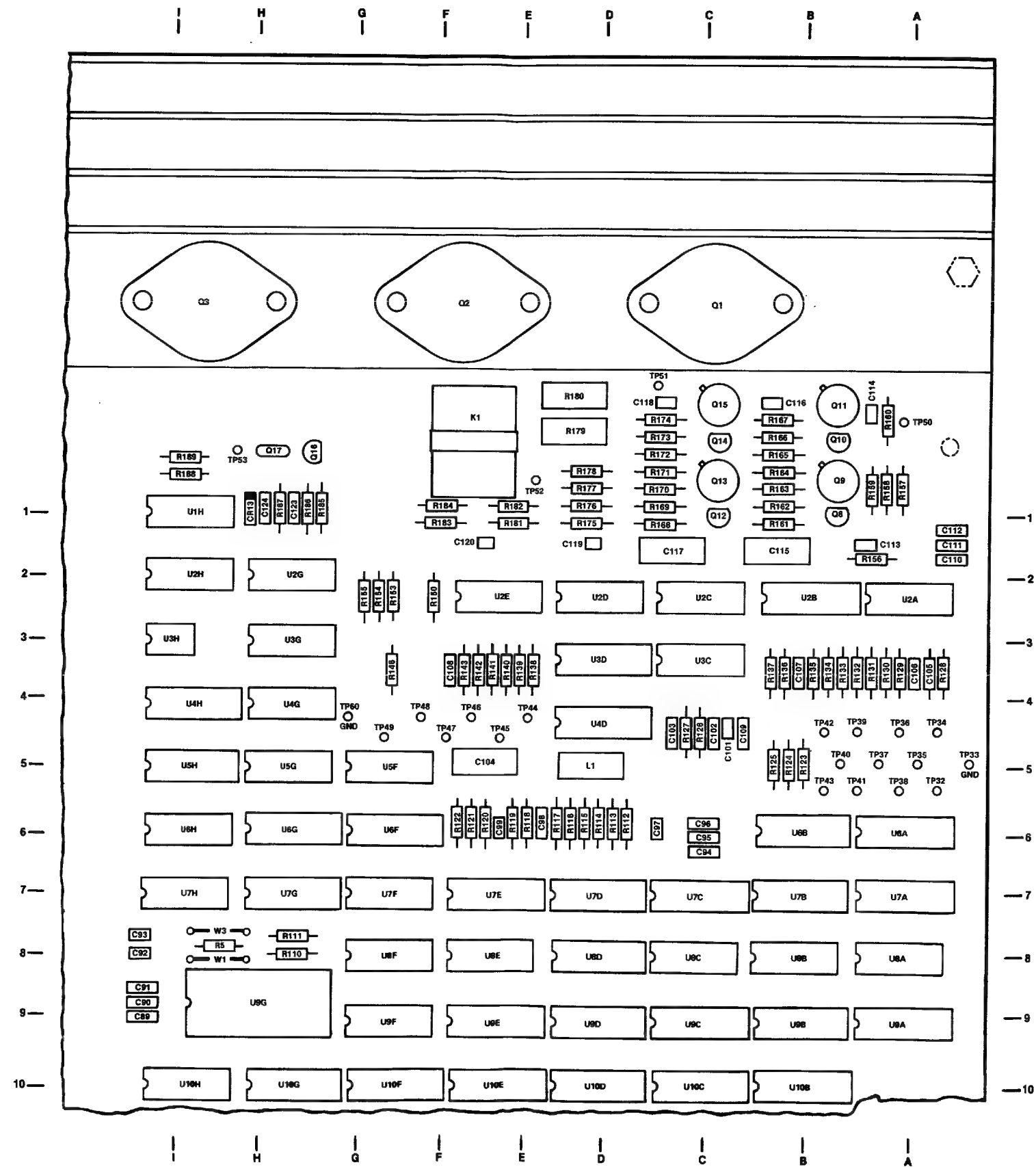


Figure 5-II. Drive Formatter PWB (Orthographic View)

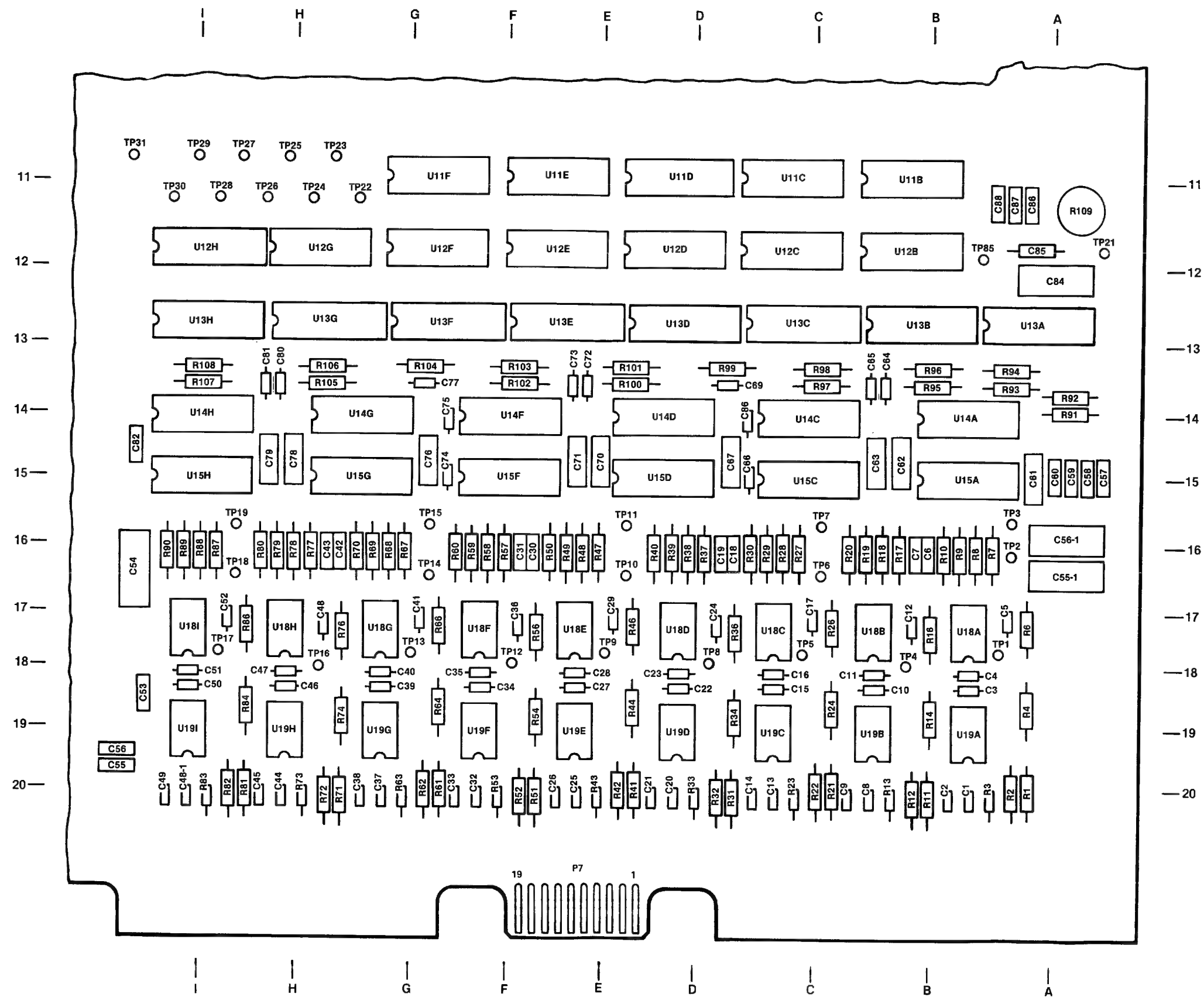


Figure 5-II. Drive Formatter PWB (Orthographic View)

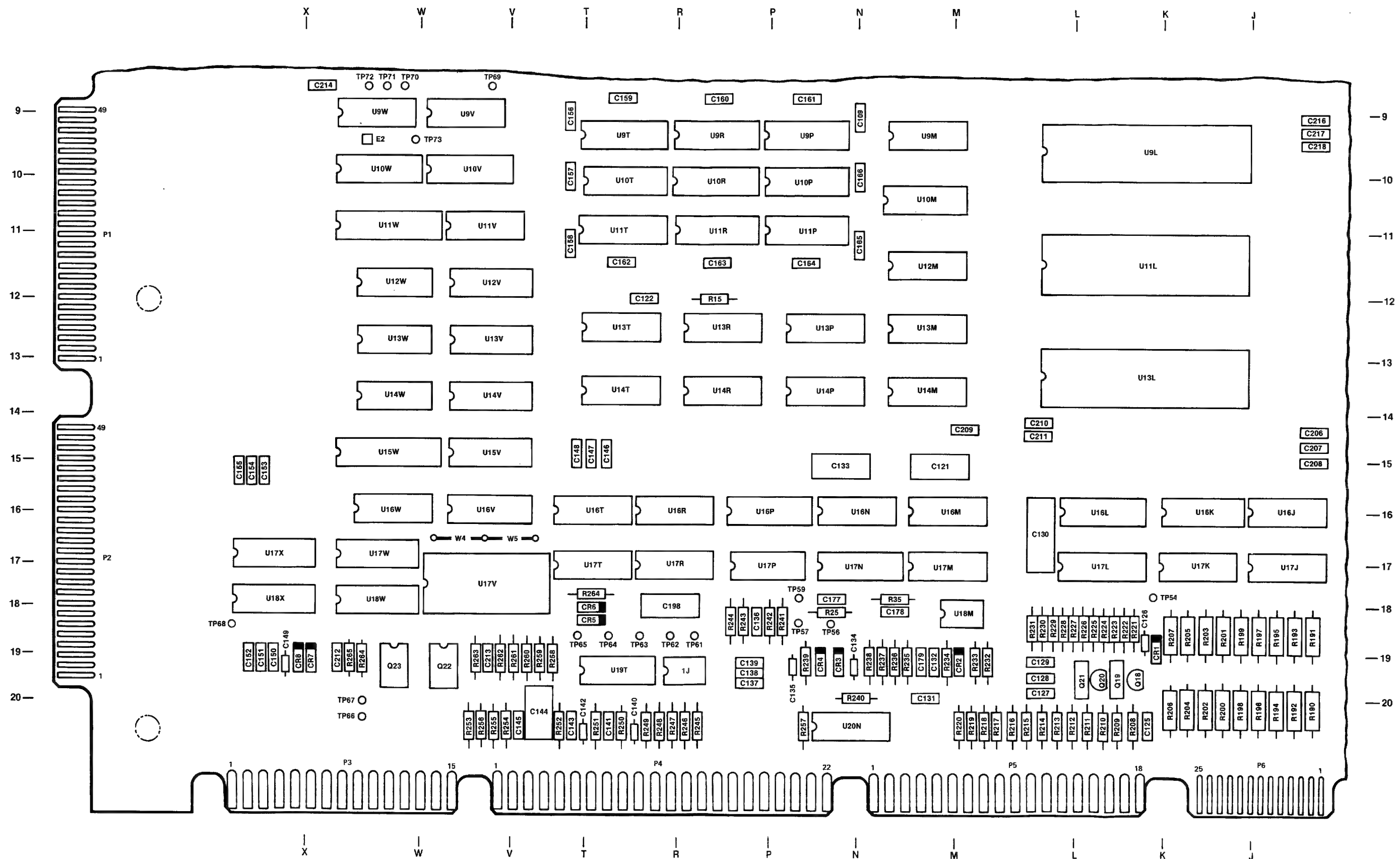


Figure 5-II. Drive Formatter PWB (Orthographic View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11	961019-001 961018-001 961020-001 961017-001	PRINTED WIRING BOARD ASSEMBLY..... Subassembly, drive-formatter (See Figure 5-6 for next higher assembly)					REF	A B C D
		(The following components are listed in alpha-numeric sequence according to their reference designation. Consult the schematic for location in the circuit.)						
C1	201114-564	. CAPACITOR, Ceramic, 0.0056 μ F $\pm 10\%$, 50V					1	
C2	201204272	. CAPACITOR, Ceramic, 27.0 pF $\pm 5\%$, 50V					1	
C3	201204-331	. CAPACITOR, Ceramic, 3.3 pF $\pm 5\%$, 50V					1	
C4	201204-472	. CAPACITOR, Ceramic, 47.0 pF $\pm 5\%$, 50V					1	
C5- C7	201114-105	. CAPACITOR, Ceramic, 0.010 μ F $\pm 10\%$, 50V					3	
C8	201114-564	. CAPACITOR, Ceramic, 0.0056 μ F $\pm 10\%$, 50V					1	
C9	201204-272	. CAPACITOR, Ceramic, 27.0 pF $\pm 5\%$, 50V					1	
C10	201204-331	. CAPACITOR, Ceramic, 3.3 pF $\pm 5\%$, 50V					1	
C11	201204-472	. CAPACITOR, Ceramic, 47.0 pF $\pm 5\%$, 50V					1	
C12	201114-105	. CAPACITOR, Ceramic, 0.010 μ F $\pm 10\%$, 50V					1	
C13	201114-564	. CAPACITOR, Ceramic, 0.0056 μ F $\pm 10\%$, 50V					1	
C14	201204-272	. CAPACITOR, Ceramic, 27.0 pF $\pm 5\%$, 50V					1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5		
5-11				
C15	201204-331	. CAPACITOR, Ceramic, 3.3 pF ±5%, 50V	1	
C16	201204-472	. CAPACITOR, Ceramic, 47.0 pF ±5%, 50V	1	
C17- C19	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	3	
C20	201114-564	. CAPACITOR, Ceramic, 0.0056 uF ±10%, 50V	1	
C21	201204-272	. CAPACITOR, Ceramic, 27.0 pF ±5%, 50V	1	
C22	201204-331	. CAPACITOR, Ceramic, 3.3 pF ±5%, 50V	1	
C23	201204-472	. CAPACITOR, Ceramic, 47.0 pF ±5%, 50V	1	
C24	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	1	
C25	201114-564	. CAPACITOR, Ceramic, 0.0056 uF ±10%, 50V	1	
C26	201204-272	. CAPACITOR, Ceramic, 27.0 pF ±5%, 50V	1	
C27	201204-331	. CAPACITOR, Ceramic, 3.3 pF ±5%, 50V	1	
C28	201204-472	. CAPACITOR, Ceramic, 47.0 pF ±5%, 50V	1	
C29, C31	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	3	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
C32	201114-564	.	CAPACITOR, Ceramic, 0.0056 uF				1	
			±10%, 50V					
C33	201204-272	.	CAPACITOR, Ceramic, 27.0 pF				1	
			±5%, 50V					
C34	201204-331	.	CAPACITOR, Ceramic, 3.3 pF				1	
			±5%, 50V					
C35	201204-472	.	CAPACITOR, Ceramic, 47.0 pF				1	
			±5%, 50V					
C36	201114-105	.	CAPACITOR, Ceramic, 0.010 uF				1	
			±10%, 50V					
C37	201114-564	.	CAPACITOR, Ceramic, 0.0056 uF				1	
			±10%, 50V					
C38	201204-272	.	CAPACITOR, Ceramic, 27.0 pF				1	
			±5%, 50V					
C39	201204-331	.	CAPACITOR, Ceramic, 3.3 pF				1	
			±5%, 50V					
C40	201204-472	.	CAPACITOR, Ceramic, 47.0 pF				1	
			±5%, 50V					
C41- C43	20114-105	.	CAPACITOR, Ceramic, 0.010 uF				3	
			±10%, 50V					
C44	201114-564	.	CAPACITOR, Ceramic, 0.0056 uF				1	
			±10%, 50V					
C45	201204-272	.	CAPACITOR, Ceramic, 27.0 pF				1	
			±5%, 50V					
C46	201204-331	.	CAPACITOR, Ceramic, 3.3 pF				1	
			±5%, 50V					
C47	201204-472	.	CAPACITOR, Ceramic, 47.0 pF				1	
			±5%, 50V					

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
C48	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	1	
C48-1	201114-564	. CAPACITOR, Ceramic, 0.0056 uF ±10%, 50V	1	
C49	201204-272	. CAPACITOR, Ceramic, 27.0 pF ±5%, 50V	1	
C50	201204-331	. CAPACITOR, Ceramic, 3.3 pF ±5%, 50V	1	
C51	201204-472	. CAPACITOR, Ceramic, 47.0 pF ±5%, 50V	1	
C52, C53	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	2	
C55-1	201160-680	. CAPACITOR, Tantalum, 6.8 uF ±10%, 35V	1	
C55- C62	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	8	
C56-1	201160-680	. CAPACITOR, Tantalum, 6.8 uF ±10%, 35V	1	
C63	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	1	
C64	201204-103	. CAPACITOR, Ceramic, 100 pF ±5%, 50V	1	
C65	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	1	
C66	201204-103	. CAPACITOR, Ceramic, 100 pF ±5%, 50V	1	
C67	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
C68, C69	201204-103	. CAPACITOR, Ceramic, 100 pF ±5%, 50V	2	
C70- C73	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	4	
C74, C75	201204-103	. CAPACITOR, Ceramic, 100 pF ±5%, 50V	2	
C76	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	1	
C77	201204-103	. CAPACITOR, Ceramic, 100 pF ±5%, 50V	1	
C78, C79	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	2	
C80, C81	201204-103	. CAPACITOR, Ceramic, 100 pF ±5%, 50V	2	
C82	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	1	
C84	201114-470	. CAPACITOR, Ceramic, 0.047 uF ±10%, 50V	1	
C85- C91	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	7	
C92, C93	201204-473	. CAPACITOR, Ceramic, 470 pF ±5%, 50V	2	
C94- C96	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	3	
C97	201204-183	. CAPACITOR, Ceramic, 180 pF ±5%, 50V	1	
C98	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
C99	201204-333	.	CAPACITOR, Ceramic, 330 pF	.....			1	
			±5%, 50V					
C100	201114-106	.	CAPACITOR, Ceramic, 0.10 uF	.....			1	
			±10%, 50V					
C101	201204-472	.	CAPACITOR, Ceramic, 47.0 pF	.....			1	
			±5%, 50V					
C102, C103	201114-105	.	CAPACITOR, Ceramic, 0.10 uF	.....			2	
			±10%, 50V					
C104	201224-224	.	CAPACITOR, Mylar, 0.22 uF	.....			1	
C105, C106	201114-154	.	CAPACITOR, Ceramic, .0015 uF	.....			2	
			±10%, 50V					
C107	201114-106	.	CAPACITOR, Ceramic, 0.10 uF	.....			1	
			±10%, 50V					
C109- C112	201114-105	.	CAPACITOR, Ceramic, 0.010 uF	.....			4	
			±10%, 50V					
C113, C114	201114-104	.	CAPACITOR, Ceramic, 0.0010 uF	.....			2	
			±10%, 50V					
C115	201224-684	.	CAPACITOR, Mylar, 0.68 uF	.....			1	
C116	201204-203	.	CAPACITOR, Ceramic, 200 pF	.....			1	
			±5%, 50V					
C117	201224-684	.	CAPACITOR, Mylar, 0.68 uF	.....			1	
C118	201204-203	.	CAPACITOR, Ceramic, 200 pF	.....			1	
			±5%, 50V					
C119- C121	201114-470	.	CAPACITOR, Ceramic, 0.047 uF	.....			3	
			±10%, 50V					
C122	201204-103	.	CAPACITOR, Ceramic, 100 pF	.....			1	
			±5%, 50V					

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5		
5-11				
C123- C125	201114-106	. CAPACITOR, Ceramic, 0.10 μ F $\pm 10\%$, 50V	3	
C126	201114-154	. CAPACITOR, Ceramic, 0.0015 μ F $\pm 10\%$, 50V	1	
C127- C129	201114-105	. CAPACITOR, Ceramic, 0.010 μ F $\pm 10\%$, 50V	3	
C130	201171-100	. CAPACITOR, Electroelectric, 10 μ F 50V	1	
C131	201123-100	. CAPACITOR, DM, 1000 pF $\pm 5\%$, 500V	1	
C132	201114-106	. CAPACITOR, Ceramic, 0.10 μ F $\pm 10\%$, 50V	1	
C133	201114-470	. CAPACITOR, Ceramic, 0.047 μ F $\pm 10\%$, 50V	1	
C134	201114-474	. CAPACITOR, Ceramic, 0.0047 μ F $\pm 10\%$, 50V	1	
C135	201204-331	. CAPACITOR, Ceramic, 3.3 pF $\pm 5\%$, 50V	1	
C136	201114-106	. CAPACITOR, Ceramic, 0.10 μ F $\pm 10\%$, 50V	1	
C137- C139	201114-105	. CAPACITOR, Ceramic, 0.010 μ F $\pm 10\%$, 50V	3	
C140	201114-334	. CAPACITOR, Ceramic, 0.0033 μ F $\pm 10\%$, 50V	1	
C141	201114-106	. CAPACITOR, Ceramic, 0.10 μ F $\pm 10\%$, 50V	1	
C142	201114-334	. CAPACITOR, Ceramic, 0.0033 μ F $\pm 10\%$, 50V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1 2 3 4 5		
5-11				
C143	201113-390	. CAPACITOR, Ceramic, 3900 pF ±10%, 50V	1	
C144	201191-006	. CAPACITOR, Aluminum, with Epoxy	1	
C145- C166	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	22	
C167	201114-154	. CAPACITOR, Ceramic, 0.0015 uF ±10%, 50V	1	
C168	201160-475	. CAPACITOR, Tantalum, mini, 4.7 uF 10V	1	
C169	201204-333	. CAPACITOR, Ceramic, 330 pF ±5%, 50V	1	
C170	201114-104	. CAPACITOR, Ceramic, 0.0010 uF ±10%, 50V	1	
C171, C172	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	2	
C173	201114-154	. CAPACITOR, Ceramic, 0.0015 uF ±10%, 50V	1	
C174	201204-153	. CAPACITOR, Ceramic, 150 pF ±5%, 50V	1	
C175, C176	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	2	
C177	201204-103	. CAPACITOR, Ceramic, 100 pF ±5%, 50V	1	
C178, C179	201114-105	. CAPACITOR, Ceramic, 0.010 uF ±10%, 50V	2	
C180	970205-001	. CAPACITOR, Ceramic, 0.1 uF ±10%, 100V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
C181- C183	201114-105	. CAPACITOR, Ceramic, 0.010 μ F \pm 10%, 50V	3	
C184- C188	201171-100	. CAPACITOR, Electrolytic, 10 μ F 50V	5	
C189, C189-1	970205-001	. CAPACITOR, Ceramic, 0.1 μ F \pm 10%, 100V	2	
C190, C191	201171-100	. CAPACITOR, Electrolytic, 10 μ F 50V	2	
C192	970205-001	. CAPACITOR, Ceramic, 0.1 μ F \pm 10%, 100V	1	
C193	970205-001	. CAPACITOR, Ceramic, 0.1 μ F \pm 10%, 100V	1	
C194	201171-100	. CAPACITOR, Electrolytic	1	
C200	201114-106	. CAPACITOR, Ceramic, 0.10 μ F \pm 10%, 50V	1	
C201- C204	201114-105	. CAPACITOR, Ceramic, 0.010 μ F \pm 10%, 50V	4	
C206- C211	201114-105	. CAPACITOR, Ceramic, 0.010 μ F \pm 10%, 50V	6	
C212, C213	201111-330	. CAPACITOR, Ceramic, 33 pF \pm 10%, 200V	2	
C214	201204-153	. CAPACITOR, Ceramic, 150 pF \pm 5%, 50V	1	
C214-1	201114-105	. CAPACITOR, Ceramic, 0.010 μ F \pm 10%, 50V	1	

REVISED _____

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
C219	201111-330	. CAPACITOR, Ceramic, 33 pF ±10%, 200V	1	
C220	201112-470	. CAPACITOR, Ceramic, 470 pF ±10%, 50V	1	
C221	201171-100	. CAPACITOR, Electrolytic, 10 uF 50V	1	
CC54	201160-680	. CAPACITOR, Tantalum, 6.8 uF ±10%, 35V	1	
CR1	202030-900	. DIODE, Silicon, VE ±5%, 5.6V	1	
CR2-6	202018-100	. DIODE, Switching	5	
CR7, CR8	202009	. DIODE, Rectifier, 1 amp.....	2	
CR9, CR10	202018-100	. DIODE, Switching	2	
CR11, CR12	202034	. DIODE, Rectifier, fast recovery	2	
CR13	202009	. DIODE, Rectifier, 1 amp.....	1	
K1	210197-200	. RELAY, 2 PDT, 10 amp, 24 Volt	1	
L1	209991-004	. INDUCTOR, 47 uHy	1	
Q1	960082-001	. TRANSISTOR, Darlington, NPN.....	1	
Q2	960081-001	. TRANSISTOR, Darlington, PNP	1	
Q3	960082-001	. TRANSISTOR, Darlington, NPN.....	1	
Q4	960081-001	. TRANSISTOR, Darlington, PNP	1	
Q5	204026-057	. TRANSISTOR, Darlington, NPN.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
Q6	204026-050	. TRANSISTOR, Darlington, PNP .....	|	
Q7	203007-500	. INTEGRATED CIRCUIT, 3 amp 5 Volt positive	|	
Q8	204010-535	. TRANSISTOR, PNP, Silicon .....	|	
Q9	204007-700	. TRANSISTOR, Power, NPN.....	|	
Q10	204010-533	. TRANSISTOR, NPN, Silicon .....	|	
Q11	204010-700	. TRANSISTOR, Power, PNP .....	|	
Q12	204010-535	. TRANSISTOR, PNP Silicon .....	|	
Q13	204007-700	. TRANSISTOR, Power, NPN.....	|	
Q14	204010-533	. TRANSISTOR, NPN, Silicon .....	|	
Q15	204010-700	. TRANSISTOR, Power, PNP .....	|	
Q16	203013-317	. INTEGRATED CIRCUIT, Regulator..... + 5V, $\pm 5\%$	|	
Q17	204027-037	. TRANSISTOR, NPN, Silicon .....	|	
Q18	204012	. TRANSISTOR, PNP, Silicon .....	|	
Q19	204027-034	. TRANSISTOR, PNP, Silicon .....	|	
Q20	204012	. TRANSISTOR, PNP, Silicon .....	|	
Q21	204027-034	. TRANSISTOR, PNP, Silicon .....	|	
Q22	204027-037	. TRANSISTOR, NPN, Silicon .....	|	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
Q23	204027-037	.	TRANSISTOR,	NPN,	Silicon	.....	1	
Q24	204010-533	.	TRANSISTOR,	NPN,	Silicon	.....	1	
Q25	204010-535	.	TRANSISTOR,	PNP,	Silicon	.....	1	
Q26	204010-533	.	TRANSISTOR,	NPN,	Silicon	.....	1	
R1	200072-100	.	RESISTOR,	FC,	100 Ohm,	1/4 W $\pm 5\%$	1	
R2	200073-330	.	RESISTOR,	FC,	3.30 K Ohm,	1/4 W $\pm 5\%$	1	
R3	200063-750	.	RESISTOR,	FC,	7.5 K Ohm,	1/8 W $\pm 5\%$	1	
R3P	203085-001	.	INTEGRATED CIRCUIT,	Schmitt.....	triggered input, Hex IV		1	
R4, R5	200074-100	.	RESISTOR,	FC,	10.00 K Ohm,	1/4 W $\pm 5\%$	1	
R5R	203085-001	.	INTEGRATED CIRCUIT,	Schmitt.....	triggered input, Hex IV		1	
R6	200074-150	.	RESISTOR,	FC,	15.00 K Ohm,	1/4 W $\pm 5\%$	1	
R7	200073-330	.	RESISTOR,	FC,	3.30 K Ohm,	1/4 W $\pm 5\%$	1	
R8, R9	200074-100	.	RESISTOR,	FC,	10.00 K Ohm,	1/4 W $\pm 5\%$	2	
R10	200073-470	.	RESISTOR,	FC,	4.70 K Ohm,	1/4 W $\pm 5\%$	1	
R11	200072-100	.	RESISTOR,	FC,	100 K Ohm,	1/4 W $\pm 5\%$	1	
R12	200073-330	.	RESISTOR,	FC,	3.30 K Ohm,	1/4 W $\pm 5\%$	1	
R13	200063-750	.	RESISTOR,	FC,	7.5 K Ohm,	1/8 W $\pm 5\%$	1	
R14	200074-100	.	RESISTOR,	FC,	10.00 K Ohm,	1/4 W $\pm 5\%$	1	
R14A, D, G	203085-001	.	INTEGRATED CIRCUIT,	Schmitt	.....	Triggered input, Hex IV	3	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
R15	200073-820	.	RESISTOR, FC, 8.20 K Ohm, 1/4 W	±5%	.....		1	
R16	200074-150	.	RESISTOR, FC, 15.00 K Ohm, 1/4 W	±5%	.....		1	
R17	200073-330	.	RESISTOR, FC, 3.30 K Ohm, 1/4 W	±5%	.....		1	
R18, R19	200074-100	.	RESISTOR, FC, 10.00 K Ohm, 1/4 W	±5%	.....		2	
R20	200073-470	.	RESISTOR, FC, 4.70 K Ohm, 1/4 W	±5%	.....		1	
R21	200072-100	.	RESISTOR, FC, 100 Ohm, 1/4 W	±5%	.....		1	
R22	200073-330	.	RESISTOR, FC, 3.30 K Ohm, 1/4 W	±5%	.....		1	
R23	200063-750	.	RESISTOR, FC, 7.5 K Ohm, 1/8 W	±5%	.....		1	
R24	200074-100	.	RESISTOR, FC, 10.00 K Ohm, 1/4 W	±5%	.....		1	
R25	200076-100	.	RESISTOR, FC, 1.00 meg ohm, 1/4 W	±5%	.....		1	
R26	200074-150	.	RESISTOR, FC, 15.00 K Ohm, 1/4 W	±5%	.....		1	
R27	200073-330	.	RESISTOR, FC, 3.30 K Ohm, 1/4 W	±5%	.....		1	
R28, R29	200074-100	.	RESISTOR, FC, 10.00 K Ohm, 1/4 W	±5%	.....		2	
R30	200073-470	.	RESISTOR, FC, 4.70 K Ohm, 1/4 W	±5%	.....		1	
R31	200072-100	.	RESISTOR, FC, 100 Ohm, 1/4 W	±5%	.....		1	
R32	200073-330	.	RESISTOR, FC, 3.30 K Ohm, 1/4 W	±5%	.....		1	
R33	200063-750	.	RESISTOR, FC, 7.5 K Ohm, 1/8 W	±5%	.....		1	
R34	200074-100	.	RESISTOR, FC, 10.00 K Ohm, 1/4 W	±5%	.....		1	
R35	200075-200	.	RESISTOR, FC, 200.00 K Ohm, 1/4 W	±5%	.....		1	
R36	200074-150	.	RESISTOR, FC, 15.00 K Ohm, 1/4 W	±5%	.....		1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
R37	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R38, R39	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	2	
R40	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	1	
R41	200072-100	. RESISTOR, FC, 100 Ohm, 1/4 W $\pm 5\%$	1	
R42	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R43	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W $\pm 5\%$	1	
R44	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	1	
R46	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W $\pm 5\%$	1	
R47	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R48, R49	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	2	
R50	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	1	
R51	200072-100	. RESISTOR, FC, 100 Ohm, 1/4 W $\pm 5\%$	1	
R52	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R53	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W $\pm 5\%$	1	
R54	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	1	
R56	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W $\pm 5\%$	1	
R57	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R58, R59	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	2	
R60	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	1	
R61	200072-100	. RESISTOR, FC, 100 Ohm, 1/4 W $\pm 5\%$	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
R62	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R63	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W $\pm 5\%$	1	
R64	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	1	
R66	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W $\pm 5\%$	1	
R67	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R68, R69	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	2	
R70	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	1	
R71	200072-100	. RESISTOR, FC, 100 Ohm, 1/4 W $\pm 5\%$	1	
R72	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R73	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W $\pm 5\%$	1	
R74	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	1	
R76	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W $\pm 5\%$	1	
R77	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R78, R79	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	2	
R80	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	1	
R81	200072-100	. RESISTOR, FC, 100 Ohm, 1/4 W $\pm 5\%$	1	
R82	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R83	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W $\pm 5\%$	1	
R84	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	1	
R86	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W $\pm 5\%$	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
R87	200073-330	.	RESISTOR,	FC,	3.30 K Ohm,	1/4 W $\pm 5\%$	1	
R88, R89	200074-100	.	RESISTOR,	FC,	10.00 K Ohm,	1/4 W $\pm 5\%$	2	
R90- R108	200073-470	.	RESISTOR,	FC,	4.70 K Ohm,	1/4 W $\pm 5\%$	19	
R109	200209-202	.	POTIOMETER,	Ceramic,	2 K Ohm.....		1	
R110, R111	200075-220	.	RESISTOR,	FC,	220.00 K Ohm,	1/4 W $\pm 5\%$	2	
R112, R113	200074-100	.	RESISTOR,	FC,	10.00 K Ohm,	1/4 W $\pm 5\%$	2	
R114	200074-620	.	RESISTOR,	FC,	62.00 K Ohm,	1/4 W $\pm 5\%$	1	
R115	200073-100	.	RESISTOR,	FC,	1.00 K Ohm,	1/4 W $\pm 5\%$	1	
R116	200074-100	.	RESISTOR,	FC,	10.00 K Ohm,	1/4 W $\pm 5\%$	1	
R117	200073-100	.	RESISTOR,	FC,	1.00 K Ohm,	1/4 W $\pm 5\%$	1	
R118	200073-150	.	RESISTOR,	FC,	1.50 K Ohm,	1/4 W $\pm 5\%$	1	
R119	200072-100	.	RESISTOR,	FC,	100 Ohm,	1/4 W $\pm 5\%$	1	
R120	200073-150	.	RESISTOR,	FC,	1.50 K Ohm,	1/4 W $\pm 5\%$	1	
R121	200023-301	.	RESISTOR,	FF,	3.01 K Ohm,	1/4 W $\pm 1\%$	1	
R122	200013-392	.	RESISTOR,	FF,	3.92 K Ohm,	1/8 W $\pm 1\%$	1	
R123, R124	200014-100	.	RESISTOR,	FF,	10.0 K Ohm,	1/8 W $\pm 1\%$	2	
R125	200074-100	.	RESISTOR,	FC,	10.00 K Ohm,	1/4 W $\pm 5\%$	1	
R126, R127	200014-100	.	RESISTOR,	FF,	10.0 K Ohm,	1/8 W $\pm 1\%$	2	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
R128	200074-510	.	RESISTOR, FC, 51.00 K Ohm, 1/4 W $\pm 5\%$				1	
R129	200075-180	.	RESISTOR, FC, 180.00 K Ohm, 1/4 W $\pm 5\%$				1	
R130	200013-475	.	RESISTOR, FF, 4.75 K Ohm, 1/8 W $\pm 1\%$				1	
R131	200074-200	.	RESISTOR, FC, 20.00 K Ohm, 1/4 W $\pm 5\%$				1	
R132	200014-100	.	RESISTOR, FF, 10.0 K Ohm, 1/8 W $\pm 1\%$				1	
R133	200074-200	.	RESISTOR, FC, 20.00 K Ohm, 1/4 W $\pm 5\%$				1	
R134	200074-150	.	RESISTOR, FC, 15.00 K Ohm, 1/4 W $\pm 5\%$				1	
R135	200075-180	.	RESISTOR, FC, 180.00 K Ohm, 1/4 W $\pm 5\%$				1	
R136	200074-150	.	RESISTOR, FC, 15.00 K Ohm, 1/4 W $\pm 5\%$				1	
R137	200013-475	.	RESISTOR, FF, 4.75 K Ohm, 1/8 W $\pm 1\%$				1	
R138	200071-820	.	RESISTOR, FC, 82 Ohm, 1/4 W $\pm 5\%$				1	
R139	200072-150	.	RESISTOR, FC, 150 Ohm, 1/4 W $\pm 5\%$				1	
R140	200014-301	.	RESISTOR, FF, 30.1 K Ohm, 1/8 W $\pm 1\%$				1	
R141	200015-100	.	RESISTOR, FF, 100 K Ohm, 1/8 W $\pm 1\%$				1	
R142	200014-100	.	RESISTOR, FF, 10.0 K Ohm, 1/8 W $\pm 1\%$				1	
R143	200074-200	.	RESISTOR, FC, 20.00 K Ohm, 1/4 W $\pm 5\%$				1	
R146	200076-510	.	RESISTOR, FC, 5.1 meg Ohm, 1/4 W $\pm 5\%$				1	
R147	200073-220	.	RESISTOR, FC, 2.20 K Ohm, 1/4 W $\pm 5\%$				1	
R148	200075-330	.	RESISTOR, FC, 330.00 K Ohm, 1/4 W $\pm 5\%$				1	
R149	200072-220	.	RESISTOR, FC, 220 Ohm, 1/4 W $\pm 5\%$				1	
R150	200073-100	.	RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$				1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
R153	200073-470	.	RESISTOR	FC	4.70 K Ohm	1/4 W $\pm 5\%$	1	
R154	200073-100	.	RESISTOR	FC	1.00 K Ohm	1/4 W $\pm 5\%$	1	
R155	200073-430	.	RESISTOR	FC	4.30 K Ohm	1/4 W $\pm 5\%$	1	
R156	200073-220	.	RESISTOR	FC	2.20 K Ohm	1/4 W $\pm 5\%$	1	
R157	200074-100	.	RESISTOR	FC	10.00 K Ohm	1/4 W $\pm 5\%$	1	
R158	200071-680	.	RESISTOR	FC	68 Ohm	1/4 W $\pm 5\%$	1	
R159	200073-220	.	RESISTOR	FC	2.20 K Ohm	1/4 W $\pm 5\%$	1	
R160	200071-680	.	RESISTOR	FC	68 Ohm	1/4 W $\pm 5\%$	1	
R161	200074-180	.	RESISTOR	FC	18.00 K Ohm	1/4 W $\pm 5\%$	1	
R162	200073-430	.	RESISTOR	FC	4.30 K Ohm	1/4 W $\pm 5\%$	1	
R163	200072-390	.	RESISTOR	FC	390 Ohm	1/4 W $\pm 5\%$	1	
R164	200073-430	.	RESISTOR	FC	4.30 K Ohm	1/4 W $\pm 5\%$	1	
R165	200074-180	.	RESISTOR	FC	18.00 K Ohm	1/4 W $\pm 5\%$	1	
R166	200073-430	.	RESISTOR	FC	4.30 K Ohm	1/4 W $\pm 5\%$	1	
R167	200072-390	.	RESISTOR	FC	390 Ohm	1/4 W $\pm 5\%$	1	
R168	200074-180	.	RESISTOR	FC	18.00 K Ohm	1/4 W $\pm 5\%$	1	
R169	200073-430	.	RESISTOR	FC	4.30 K Ohm	1/4 W $\pm 5\%$	1	
R170	200072-390	.	RESISTOR	FC	390 Ohm	1/4 W $\pm 5\%$	1	
R171	200073-430	.	RESISTOR	FC	4.30 K Ohm	1/4 W $\pm 5\%$	1	
R172	200074-180	.	RESISTOR	FC	18.00 K Ohm	1/4 W $\pm 5\%$	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
R173	200073-430	. RESISTOR, FC, 4.30 K Ohm, 1/4 W $\pm 5\%$	1	
R174	200072-390	. RESISTOR, FC, 390 Ohm, 1/4 W $\pm 5\%$	1	
R175, R176	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$	2	
R177, R178	200015-100	. RESISTOR, FF, 100 K Ohm, 1/8 W $\pm 1\%$	2	
R179, R180	200509-100	. RESISTOR, WW, 1 Ohm, 3 W $\pm 1\%$	2	
R181	200014-301	. RESISTOR, FF, 30.1 K Ohm, 1/8 W $\pm 1\%$	1	
R182	200015-100	. RESISTOR, FF, 100 K Ohm, 1/8 W $\pm 1\%$	1	
R183, R184	200013-100	. RESISTOR, FF, 1.00 K Ohm, 1/8 W $\pm 1\%$	2	
R185	200073-220	. RESISTOR, FC, 2.20 K Ohm, 1/4 W $\pm 5\%$	1	
R186	200072-200	. RESISTOR, FC, 200 Ohm, 1/4 W $\pm 5\%$	1	
R187	200074-220	. RESISTOR, FC, 22.00 K Ohm, 1/4 W $\pm 5\%$	1	
R188	200013-392	. RESISTOR, FF, 3.92 K Ohm, 1/8 W $\pm 1\%$	1	
R189	200013-475	. RESISTOR, FF, 4.75 K Ohm, 1/8 W $\pm 1\%$	1	
R190	200082-470	. RESISTOR, FC, 470 Ohm, 1/2 W $\pm 5\%$	1	
R191, R192	200082-560	. RESISTOR, FC, 560 Ohm, 1/2 W $\pm 5\%$	2	
R193, R195	200082-470	. RESISTOR, FC, 470 Ohm, 1/2 W $\pm 5\%$	3	
R196	200082-560	. RESISTOR, FC, 560 Ohm, 1/2 W $\pm 5\%$	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
R197	200082-560	. RESISTOR, FC, 560 Ohm, 1/2 W $\pm 5\%$	1	
R198	200082-470	. RESISTOR, FC, 470 Ohm, 1/2 W $\pm 5\%$	1	
R199, R200	200082-560	. RESISTOR, FC, 560 Ohm, 1/2 W $\pm 5\%$	2	
R201	200082-470	. RESISTOR, FC, 470 Ohm, 1/2 W $\pm 5\%$	1	
R202	200082-560	. RESISTOR, FC, 560 Ohm, 1/2 W $\pm 5\%$	1	
R203, R204	200082-470	. RESISTOR, FC, 470 Ohm, 1/2 W $\pm 5\%$	2	
R205	200082-560	. RESISTOR, FC, 560 Ohm, 1/2 W $\pm 5\%$	1	
R206	200082-470	. RESISTOR, FC, 470 Ohm, 1/2 W $\pm 5\%$	1	
R207	200082-560	. RESISTOR, FC, 560 Ohm, 1/2 W $\pm 5\%$	1	
R208	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W $\pm 5\%$	1	
R209	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W $\pm 5\%$	1	
R210	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W $\pm 5\%$	1	
R211	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W $\pm 5\%$	1	
R212	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W $\pm 5\%$	1	
R213	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W $\pm 5\%$	1	
R214	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W $\pm 5\%$	1	
R215	200072-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W $\pm 5\%$	1	
R216	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W $\pm 5\%$	1	
R217	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W $\pm 5\%$	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
R218	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W $\pm 5\%$	1	
R219	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W $\pm 5\%$	1	
R220	200071-150	. RESISTOR, FC, 15 Ohm, 1/4 W $\pm 5\%$	1	
R221	200071-330	. RESISTOR, FC, 33 Ohm, 1/4 W $\pm 5\%$	1	
R222	200072-240	. RESISTOR, FC, 240 Ohm, 1/4 W $\pm 5\%$	1	
R223	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$	1	
R224	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W $\pm 5\%$	1	
R225	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	1	
R226	200073-150	. RESISTOR, FC, 1.50 K Ohm, 1/4 W $\pm 5\%$	1	
R227	200073-220	. RESISTOR, FC, 2.20 K Ohm, 1/4 W $\pm 5\%$	1	
R228	200074-100	. RESISTOR, FC, 10.0 K Ohm, 1/4 W $\pm 5\%$	1	
R229- R231	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W $\pm 5\%$	3	
R232	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$	1	
R233	200071-150	. RESISTOR, FC, 15 Ohm, 1/4 $\pm 5\%$	1	
R234	200014-100	. RESISTOR, FF, 10.0 K Ohm, 1/8 W $\pm 1\%$	1	
R235, R236	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	2	
R237	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W $\pm 5\%$	1	
R238	200076-470	. RESISTOR, FC, 4.70 meg Ohm, 1/4 W $\pm 5\%$	1	
R239	200016-100	. RESISTOR, FF, 1.00 meg Ohm, 1/8 W $\pm 1\%$	1	
R240	200076-470	. RESISTOR, FC, 4.70 meg Ohm, 1/4 W $\pm 5\%$	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
R241	200073-130	. RESISTOR, FC, 1.30 K Ohm, 1/4 W $\pm 5\%$	1	
R242	200074-220	. RESISTOR, FC, 22.00 K Ohm, 1/4 W $\pm 5\%$	1	
R243	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$	1	
R245	200073-130	. RESISTOR, FC, 1.30 K Ohm, 1/4 W $\pm 5\%$	1	
R246	200072-150	. RESISTOR, FC, 150 Ohm, 1/4 W $\pm 5\%$	1	
R247	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	1	
R248	200072-430	. RESISTOR, FC, 430 Ohm, 1/4 W $\pm 5\%$	1	
R249	200072-150	. RESISTOR, FC, 150 Ohm, 1/4 W. $\pm 5\%$	1	
R250	200072-430	. RESISTOR, FC, 430 Ohm, 1/4 W $\pm 5\%$	1	
R251	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	1	
R252	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	1	
R253	200072-430	. RESISTOR, FC, 430 Ohm, 1/4 W $\pm 5\%$	1	
R254	200070-560	. RESISTOR, FC, 5.60 Ohm, 1/4 W $\pm 5\%$	1	
R255	200072-150	. RESISTOR, FC, 150 Ohm 1/4 W 5%.	1	
R256	200074-430	. RESISTOR, FC, 43.00 K Ohm, 1/4 W $\pm 5\%$	1	
R257	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$	1	
R258	200074-430	. RESISTOR, FC, 43.00 K Ohm, 1/4 W $\pm 5\%$	1	
R259	200074-100	. RESISTOR, FC, 10.0 K Ohm, 1/4 W $\pm 5\%$	1	
R260	200074-120	. RESISTOR, FC, 12.00 K Ohm, 1/4 W $\pm 5\%$	1	
R261- R263	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W $\pm 5\%$	3	
R264	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W $\pm 5\%$	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
R264-1	200074-220	. RESISTOR, FC, 22.00 K Ohm, 1/4 W $\pm 5\%$	1	
R265	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W $\pm 5\%$	1	
R267	200013-249	. RESISTOR, FF, 2.49 K Ohm, 1/8 W $\pm 5\%$	1	
R268- R170	200013-499	. RESISTOR, FF, 4.99 K Ohm, 1/8 W $\pm 5\%$	3	
R271	2000520-100	. RESISTOR, FC, 1 Ohm.....	1	
R272- R274	200072-330	. RESISTOR, FC, 330 Ohm 1/4 W $\pm 5\%$	3	
R275	200013-499	. RESISTOR, FF, 4.99 K Ohm, 1/8 W $\pm 5\%$	1	
R276, R277	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	2	
R278	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$	1	
R279	200072-680	. RESISTOR, FC, 680 Ohm, 1/4 W $\pm 5\%$	1	
R280	200082-510	. RESISTOR, FC, 510 Ohm 1/2 W $\pm 5\%$	2	
R281	200072-750	. RESISTOR, FC, 750 Ohm 1/4 W $\pm 5\%$	1	
R282, R283	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W $\pm 5\%$	2	
R284- R292	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$	9	
R293, R294	200093-150	. RESISTOR, FC, 1.5 K Ohm, 1 W $\pm 5\%$	2	
R295	200073-100	. RESISTOR, FC, 1.00 K Ohm , 1/4 W $\pm 5\%$	1	
R296	200072-270	. RESISTOR, FC, 270 Ohm, 1/4 W $\pm 5\%$	1	
R297	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W $\pm 5\%$	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
R298	200072-270	.	RESISTOR, FC, 270 Ohm, 1/4 W	±5%.....			1	
R299	200072-220	.	RESISTOR, FC, 220 Ohm, 1/4 W	±5%.....			1	
R300	200073-470	.	RESISTOR, FC, 4.70 K Ohm, 1/4 W	±5%.....			1	
R301	200072-330	.	RESISTOR, FC, 330 Ohm, 1/4 W	±5%.....			1	
R302- R305	200073-330	.	RESISTOR, FC, 3.30 K Ohm, 1/4 W	±5%.....			4	
R306	200071-220	.	RESISTOR, FC, 22 Ohm, 1/4 W	±5%.....			1	
R307	200072-750	.	RESISTOR, FC, 750 Ohm, 1/4 W	5%.....			1	
R308	200073-120	.	RESISTOR, FC, 1.20 K, 1/4 W	±5%.....			1	
R309- R311	200074-100	.	RESISTOR, FC, 10.00 K Ohm, 1/4 W	±5%.....			3	
R312	2000214-102	.	POTIOMETER, PC, 1 K Ohm.	.....			1	
R313	200072-750	.	RESISTOR, FC, 750 Ohm, 1/4 W	±5%.....			1	
R314	200073-110	.	RESISTOR, FC, 1.10 K Ohm, 1/4 W	±5%.....			1	
R315, R316	200073-100	.	RESISTOR, FC, 1.00 K Ohm, 1/4 W	±5%.....			2	
R317	200074-100	.	RESISTOR, FC, 10.00 K Ohm, 1/4 W	±5%.....			1	
R318	200073-240	.	RESISTOR, FC, 2.40 K Ohm, 1/4 W	±5%.....			1	
R319	200073-120	.	RESISTOR, FC, 1.20 K Ohm, 1/4 W	±5%.....			1	
R320	200076-100	.	RESISTOR, FC, 1.00 meg Ohm, 1/4 W	±5%.....			1	
R321	200072-220	.	RESISTOR, FC, 220 Ohm, 1/4 W	±5%.....			1	
TP1- TP19	205026	.	TEST POINT 0.058 in dia pin.....				19	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
TP21- TP54	205026	.	TEST POINT	0.058	in dia pin.....		34	
TP56, TP57	205026	.	TEST POINT	0.058	in dia pin.....		2	
TP59- TP86	205026	.	TEST POINT	0.058	in dia pin.....		28	
UIH	203035-032	.	INTEGRATED CIRCUIT, Quad 2 input		positive OR gate		1	
UIK	203046-150	.	INTEGRATED CIRCUIT, BCD-to-Decimal.....		decoder		1	
UIL	203102-373	.	INTEGRATED CIRCUIT, Octal		D-type latch		1	
UIP	203027-001	.	INTEGRATED CIRCUIT, Quad 2-input		positive and gate		1	
U2A	203012-136	.	INTEGRATED CIRCUIT, Quad operational		amplifiers		1	
U2B	203052-053	.	INTEGRATED CIRCUIT, Multiplxr, triple		2 channel		1	
U2C	203012-136	.	INTEGRATED CIRCUIT, Quad operational		amplifiers		1	
U2E	203031-050	.	INTEGRATED CIRCUIT, Dual 4-input		positive NAND gate		1	
U2G	970221-001	.	INTEGRATED CIRCUIT, Quad 2-input		positive NAND gate		1	
U2K	203026-999	.	INTEGRATED CIRCUIT, Hex inverter				1	
U2L	203102-373	.	INTEGRATED CIRCUIT, Octal D-type latch.....				1	
U2N	203575-110	.	INTEGRATED CIRCUIT, CPU, 16 bit, 4 MHz				1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
U2P	203035-032	. INTEGRATED CIRCUIT, Quad 2-input positive OR gate	1	
U2T	203554-001	. INTEGRATED CIRCUIT, DMA, 8 bit, 4 MHz	1	
U2V	203026-001	. INTEGRATED CIRCUIT, Hex inverter	1	
U2W	203102-375	. INTEGRATED CIRCUIT, D Flop, octal	1	
U3C	203071-999	. INTEGRATED CIRCUIT, Dual V cont, MLTV	1	
U3D	203094-501	. INTEGRATED CIRCUIT, Dual J-K, positive edge trigger	1	
U3G	203029-003	. INTEGRATED CIRCUIT, Trip, 3-input	1	
U3H	203007-393	. INTEGRATED CIRCUIT, Comparator, low	1	
U3K	203042-510	. INTEGRATED CIRCUIT, Counter/Latch	1	
U3L	961220-001	. SOFTWARE ASSY, High ROM	1	A
U3L	961222-001	. SOFTWARE ASSY, High ROM	1	B
U3L	961223-001	. SOFTWARE ASSY, High ROM	1	C
U3L	961221-001	. SOFTWARE ASSY, High ROM	1	D
U3N	203075-002	. INTEGRATED CIRCUIT, 2 K X 8 RAM	1	
U3R	203030-367	. INTEGRATED CIRCUIT, Hex bus driver	1	
U3T	211015-003	. SWITCH Dip, 8 position, sealed	1	
U3V	970221-001	. INTEGRATED CIRCUIT, Quad 2-input	1	
U3W	205255-500	. RESISTOR, Network, 220/330 Ohm	1	
U4D	203048-150	. INTEGRATED CIRCUIT, synchronous 4	1	
U4G, U4H	203026-001	. INTEGRATED CIRCUIT, Hex inverter	2	

REVISED _____

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
U4P	970010-001	. INTEGRATED CIRCUIT, Quad 2-input positive AND gate	1	
U4R	203030-367	. INTEGRATED CIRCUIT, Hex bus driver.....	1	
U4T	205257-101	. RESISTOR Network, 10 K Ohm.....	1	
U4V	203029-003	. INTEGRATED CIRCUIT, Trip, 3-input AND gate	1	
U4W	203042-001	. INTEGRATED CIRCUIT, Quad XOR gate.....	1	
U5F	203029-010	. INTEGRATED CIRCUIT, Triple 3-input AND gate	1	
U5G	203012-999	. INTEGRATED CIRCUIT, Phase freq detector ...	1	
U5H	203094-501	. INTEGRATED CIRCUIT, Dual J-K positive edge trigger	1	
U5K	203035-032	. INTEGRATED CIRCUIT, Quad 2-input positive OR gate	1	
U5L	961220-002	. SOFTWARE ASSY, Low ROM.....	1	A
U5L	961222-002	. SOFTWARE ASSY, Low ROM.....	1	B
U5L	961223-002	. SOFTWARE ASSY, Low ROM.....	1	C
U5L	961221-002	. SOFTWARE ASSY, Low ROM.....	1	D
U5N	203075-002	. INTEGRATED CIRCUIT, 2K X 8 RAM	1	
U5P	203039-001	. INTEGRATED CIRCUIT, Dual D flip-flop	1	
U5T	203052-244	. INTEGRATED CIRCUIT, Octal buffer,..... tri-state	1	
U5V	970221-001	. INTEGRATED CIRCUIT, Quad 2-input positive NAND gate	1	
U5W	211015-003	. SWITCH Dip, 8 position sealed	1	
U6A, U6B	203094-501	. INTEGRATED CIRCUIT, Dual J-K, positive edge trigger	2	
U6F, U6G	203051-174	. INTEGRATED CIRCUIT, Hex D-type flip-flop	2	

REVISED _____

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
U6H	203007-700	.	INTEGRATED	CIRCUIT,	Voltage	comparator	1	
U6J- U6K U6L	203130-999	.	INTEGRATED	CIRCUIT,	JFET	input, op amp	3	
U6M	203550-001	.	INTEGRATED	CIRCUIT,	D to A,	10 bit	1	
U6N	203550-501	.	INTEGRATED	CIRCUIT,	A to D,	10 bit	1	
U6P	203082-500	.	INTEGRATED	CIRCUIT,	Hex	buffer/drivers	1	
U6R	203035-032	.	INTEGRATED	CIRCUIT,	Quad	2-input	1	
					positive	OR gate		
U6T	203102-373	.	INTEGRATED	CIRCUIT,	Octal	D-type latch	1	
U6V	203051-174	.	INTEGRATED	CIRCUIT,	Hex	D-type	1	
					flip-flop			
U6W	203046-148	.	INTEGRATED	CIRCUIT,	3-8	Line decoder	1	
U7A, U7B	203094-501	.	INTEGRATED	CIRCUIT,	Dual	J-K, positive	2	
					edge	trigger		
U7C	203046-151	.	INTEGRATED	CIRCUIT,	1 to	8 data.	1	
					select	multiplexer		
U7D	203048-150	.	INTEGRATED	CIRCUIT,	Synchronous	4	1	
					bit	counter		
U7E	203046-153	.	INTEGRATED	CIRCUIT,	4-1	Line	1	
					select	multiplexer		
U7F	203049-164	.	INTEGRATED	CIRCUIT	8 Bit	parallel	1	
					output			
U7G	160102-445	.	SOFTWARE	ASSY,	PE	controller	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
U7H	203027-001	. INTEGRATED CIRCUIT, Quad 2-input positive AND gate	1	
U7J, U7N	203052-051	. INTEGRATED CIRCUIT, MULTIPLXER, 8 channel	2	
U7P	203046-132	. INTEGRATED CIRCUIT, Quad, 2-input	1	
U7R, U7T	203102-245	. INTEGRATED CIRCUIT, Octal bus tranceivers	2	
U7V	203027-001	. INTEGRATED CIRCUIT, Quad 2-input positive AND gate	1	
U7W	203036	. INTEGRATED CIRCUIT, Quad 2-input positive NAND buffer	1	
U8A- U8L	203026-001	. INTEGRATED CIRCUIT, Hex inverter	3	
U8D	203046-148	. INTEGRATED CIRCUIT, 3-8 Line decoder.....	1	
U8E, U8F	203049-164	. INTEGRATED CIRCUIT, 8 Bit parallel..... output	2	
U8V	970221-001	. INTEGRATED CIRCUIT, Quad 2-input positive NAND	1	
U8W	203036	. INTEGRATED CIRCUIT, Quad 2-input positive NAND buffer	1	
U9A- U9D	203048-150	. INTEGRATED CIRCUIT, Synchronous 4 bit counter	4	
U9E	203047-157	. INTEGRATED CIRCUIT, Quad 2 to 1 line, data	1	
U9F	203049-164	. INTEGRATED CIRCUIT 8-Bit parallel output	1	
U9G	160101-447	. SOFTWARE Assembly, Read deskew	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
U9L	203555-110	.	INTEGRATED	CIRCUIT,	CIO,	16 bit, 4 MHz.....	1	
U9M	203035-032	.	INTEGRATED	CIRCUIT,	Quad 2 input	positive OR gate	1	
U9P, U9R, U9T	203564-123	.	INTEGRATED	CIRCUIT,	Memory MOS.....	RAM 64 K x 1	3	
U9W	203036	.	INTEGRATED	CIRCUIT,	Quad 2 input	positive NAND buffer	1	
U10B- U10E	203048-150	.	INTEGRATED	CIRCUIT,	Synchronous 4 bit	counter	4	
U10F, U10G	203046-151	.	INTEGRATED	CIRCUIT,	1 of 8 Data	select multiplexer	2	
U10H	203082-500	.	INTEGRATED	CIRCUIT,	Hex buff/drivers.....		1	
U10M	203051-100	.	INTEGRATED	CIRCUIT,	Quad, D-type.....	flip flop	1	
U10P, U10R, U10T	203564-123	.	INTEGRATED	CIRCUIT,	Memory MOS.....	RAM 64 K x 1	3	
U10W	205255-500	.	RESISTOR	Network,	220/330 Ohm.....		1	
U11B, U11C	970221-001	.	INTEGRATED	CIRCUIT,	Quad 2 input	positive NAND gate	2	
U11D	203048-150	.	INTEGRATED	CIRCUIT,	Synchronous.....	4 bit counter	1	
U11E, U11F	970221-001	.	INTEGRATED	CIRCUIT,	Quad 2 input	positive NAND gate	2	
U11L	203555-110	.	INTEGRATED	CIRCUIT,	CIO,	16 bit, 4 MHz.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
UI1P, UI1R, UI1T	203564-123	.	INTEGRATED	CIRCUIT,	Memory MOS.....	RAM 64 K x 1	3	
UI1V	203061-280	.	INTEGRATED	CIRCUIT,	Parity tree, 9 input		1	
UI1W	203030-202	.	INTEGRATED	CIRCUIT,	Octal, bus driver.....		1	
UI2B, UI2C, UI2D	203042-001	.	INTEGRATED	CIRCUIT,	Quad XOR gate.....		3	
UI2E	970221-001	.	INTEGRATED	CIRCUIT,	Quad 2 input	positive NAND gate	1	
UI2F, UI2G, UI2H	203042-001	.	INTEGRATED	CIRCUIT,	Quad XOR gate.....		2	
	160101-461	.	SOFTWARE	Assembly	data drop		1	
UI2M	203035-032	.	INTEGRATED	CIRCUIT,	Quad 2 input	positive OR gate	1	
UI2V	203051-100	.	INTEGRATED	CIRCUIT,	Quad D-type	flip flop	1	
UI3A	203051-174	.	INTEGRATED	CIRCUIT,	Hex D-type	flip flop	1	
UI3B, UI3C	203094-501	.	INTEGRATED	CIRCUIT,	Dual J-K	positive edge trigger	2	
UI3D	203051-174	.	INTEGRATED	CIRCUIT,	Hex D-type	flip flop	1	
UI3E, UI3F	203094-501	.	INTEGRATED	CIRCUIT,	Dual J-K	positive edge trigger	2	
UI3G	203051-174	.	INTEGRATED	CIRCUIT,	Hex D-type	flip flop	1	
UI3H	203094-501	.	INTEGRATED	CIRCUIT,	Dual J-K	positive edge trigger	1	

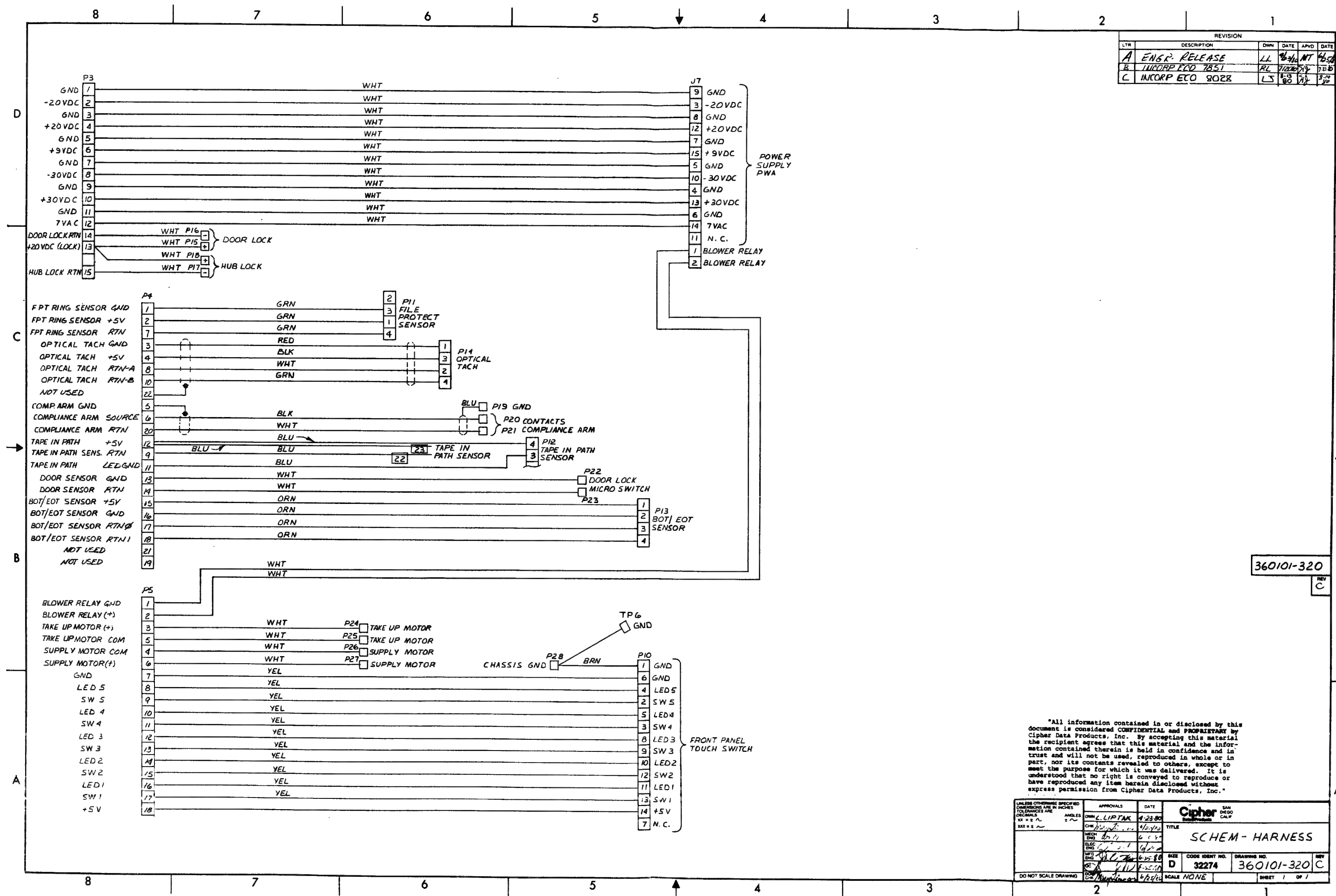
FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
UI3L	203555-110	.	INTEGRATED	CIRCUIT,	CIO,	16 bit, 4 MHz.....	1	
UI3M	203035-032	.	INTEGRATED	CIRCUIT,	Quad 2 input,.....	positive OR gate	1	
UI3P	203036-039	.	INTEGRATED	CIRCUIT,	Quad bus buffer	.....	1	
UI3R	203039-001	.	INTEGRATED	CIRCUIT,	Dual-D flip flop	.....	1	
UI3T	203044	.	INTEGRATED	CIRCUIT,	MNST MLTV	.....	1	
UI3V	203051-174	.	INTEGRATED	CIRCUIT,	Hex D-type flip flop....		1	
UI3W	203039-001	.	INTEGRATED	CIRCUIT,	Dual-D flip flop	.....	1	
UI4D, UI4F, UI4H	203007-350	.	INTEGRATED	CIRCUIT,	Volt comp buffer	.....	3	
UI4M	203036	.	INTEGRATED	CIRCUIT,	Quad 2 input	.....	1	
					positive NAND buffer			
UI4P	203039-001	.	INTEGRATED	CIRCUIT,	Dual-D flip flop	.....	1	
UI4R	970010-001	.	INTEGRATED	CIRCUIT,	Quad 2 input	.....	1	
					positive AND gate			
UI4T	203039-001	.	INTEGRATED	CIRCUIT,	Dual D-Flip flop	.....	1	
UI4V	203051-100	.	INTEGRATED	CIRCUIT,	Quad D-type	.....	1	
					flip flop			
UI4W	203049-164	.	INTEGRATED	CIRCUIT,	8-bit parallel.....	output	1	
UI5A, UI5C, UI5D, UI5F- UI5H	203007-350	.	INTEGRATED	CIRCUIT,	Voltage.....	comp/buffer	6	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
U15V	203051-174	.	INTEGRATED	CIRCUIT,	Hex	D-type flip flop....	1	
U15W	203102-375	.	INTEGRATED	CIRCUIT,	D-flop,	octal	1	
U16J	203026-500	.	INTEGRATED	CIRCUIT,	Hex inverter	buffer/driver	1	
U16K	203051-174	.	INTEGRATED	CIRCUIT,	Hex	D-type flip flop....	1	
U16L	203122-368	.	INTEGRATED	CIRCUIT,	Hex	bus driver.....	1	
U16M, U16N	203042-001	.	INTEGRATED	CIRCUIT,	Quad	XOR gate.....	2	
U16P	203051-174	.	INTEGRATED	CIRCUIT,	Hex	D-type flip flop....	1	
U16R	203029-002	.	INTEGRATED	CIRCUIT,	Triple 3-input	positive NAND gate	1	
U16T	203026-001	.	INTEGRATED	CIRCUIT,	Hex	inverter	1	
U16V	203051-174	.	INTEGRATED	CIRCUIT,	Hex	D-type flip flop....	1	
U16W	203027-001	.	INTEGRATED	CIRCUIT,	Quad 2-input	positive NAND gate	1	
U17J, U17K	203082-500	.	INTEGRATED	CIRCUIT,	Hex	buffer/drivers	2	
U17L	203051-100	.	INTEGRATED	CIRCUIT,	Quad	D-type flip flop...	1	
U17M	203042-001	.	INTEGRATED	CIRCUIT,	Quad	XOR gate.....	1	
U17N	203051-100	.	INTEGRATED	CIRCUIT,	Quad	D-type flip flop...	1	
U17P	203029-500	.	INTEGRATED	CIRCUIT,	Hex	ST inverter	1	
U17R	203039-001	.	INTEGRATED	CIRCUIT,	D-flip flop		1	
U17T	970221-001	.	INTEGRATED	CIRCUIT,	Quad 2-input	positive NAND gate	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11				
U17V	960422-001	. SOFTWARE ASSY, Write.....	1	
U17W	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	1	
U17X	203026-500	. INTEGRATED CIRCUIT, Hex inverter buffer/driver	1	
U18A- U18I, U18M	203130	. INTEGRATED CIRCUIT, Jfet input..... operational amplifier	10	
U18W	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	1	
U18X	203026-500	. INTEGRATED CIRCUIT, Hex inverter buffer/driver	1	
U19A- U19I	203043-500	. INTEGRATED CIRCUIT, Operational amplifier, high performance	9	
U19T	203007-700	. INTEGRATED CIRCUIT, Voltage comparator	1	
U20N	203012-136	. INTEGRATED CIRCUIT, Quad operational amplifier	1	
VR1	203013-300	. INTEGRATED CIRCUIT, Voltage regulator	1	
VR2	203013-320	. INTEGRATED CIRCUIT, Voltage regulator	1	
XJ1	211011-008	. SOCKET, 8 pin, low profile.....	1	
XQ9, XQ11, XQ13 XQ15	211116	. TRANSIPAD TO-5	4	
XU2N, XU2T	211011-040	. SOCKET, 40 pin, low profile.....	2	
XU3L	211011-028	. SOCKET, 28 pin, low profile.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION					UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5		
5-11								
XU9G	211011-024	.	SOCKET, 24 pin, low profile.....				1	
XU9L	211011-040	.	SOCKET, 40 pin, low profile.....				1	
XU9T, XU9P, XU9T, XU9W	211011-016	.	SOCKET, 16 pin, low profile.....				4	
XU11L	211011-040	.	SOCKET, 40 pin, low profile.....				1	
XU11P, XU11R, XU11T XU12H	211011-016	.	SOCKET, 16 pin, low profile.....				4	
XU13L	211011-040	.	SOCKET, 40 pin, low profile.....				1	
XUK1	211078-999	.	SOCKET, relay				1	
XUX7G, XUXU3W	211011-016	.	SOCKET, 16 pin, low profile.....				2	
XUXU5L	211011-028	.	SOCKET, 28 pin, low profile.....				1	
XUXU9P, XUXU9R	211011-016	.	SOCKET, 16 pin, low profile.....				2	
XU17V	211011-024	.	SOCKET, 24 pin, low profile.....				1	
Y1	210111-768	.	CRYSTAL, 7.680 MHz				1	

REVISION					
LYR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENGR. RELEASE	LL	8/31/80	NT	8/31/80
B	INCORP ECD 7851	RL	7/22/80	NT	7/22/80
C	INCORP ECD 8028	LS	8/13/80	NT	8/13/80

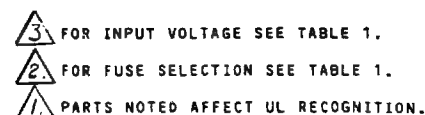


*All information contained in or disclosed by this document is considered CONFIDENTIAL and PROPRIETARY by Cipher Data Products, Inc. By accepting this material the recipient agrees that this material and the information contained therein is held in confidence and in trust and will not be used, reproduced in whole or in part, nor its contents revealed to others, except to meet the purpose for which it was delivered. It is understood that no right is conveyed to reproduce or have reproduced any item herein disclosed without express permission from Cipher Data Products, Inc.

APPROVALS		DATE	CIPHER DATA PRODUCTS	
OWN	C. LIPKIN	4-23-80	TITLE	SCHEM - HARNESS
CHK		6/25/80	SIZE	D
MECH		6/25/80	CODE IDENT NO.	32274
ELEC		6/25/80	DRAWING NO.	360101-320
ENGR		6/25/80	REV	C
DO NOT SCALE DRAWING		6/25/80	SCALE	NONE
			SHEET	1 OF 1

TABLE 1

360105-320



"All information contained in or disclosed by this document is considered CONFIDENTIAL and PROPRIETARY by Cipher Data Products, Inc. By accepting this material the recipient agrees that this material and the information contained therein is held in confidence and in trust and will not be used, reproduced in whole or in part, nor its contents revealed to others, except to meet the purpose for which it was delivered. It is understood that no right is conveyed to reproduce or have reproduced any item herein disclosed without express permission from Cipher Data Products, Inc."

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS XX ± .02 XXX ± .05	APPROVALS DESIGNED BY: <u>F. Dahne</u> CHECKED BY: <u>J. J. B.</u>	DATE <u>6/11/82</u> <u>6-28-82</u>	CIPHER San Diego CALIF.	
	ANGLES ± .5°	MECH ENG: <u>[Signature]</u> ELEC ENG: <u>[Signature]</u> MFG ENG: <u>[Signature]</u> QC: <u>[Signature]</u>	TITLE SCHEM- POWER SUPPLY	SIZE C	CODE IDENT NO. 32274
DO NOT SCALE DRAWING	DOC: <u>C. H. B. B.</u> <u>11/1/82</u>	SCALE NONE	DRAWING NO. 360105-320	SHEET 1 OF 1

8

7

6

5

4

3

2

1

5 SWITCHES - U3T: OPERATIONS OPTION SWITCH.
U5W: FMTR ADDRESS SELECT.

6 JUMPERS W1, W3, W4, W5 FOR FUTURE USE.

7. \downarrow DENOTES +5R GROUND

NOTES:

1. RESISTOR VALUES ARE IN OHMS, $\frac{1}{4}$ W, 5%.
2. CAPACITOR VALUES ARE IN MICROFARADS.
3. IC VCC & GND PINS UNUSED PORTIONS:
 - a. +5R & +5V DEVICES:

IC TYPE	REFERENCE DESIGNATOR	+5R	+5V	GND	UNUSED
74LS00	U2G, U3V, U5V, U8V, U11B, U11C, U11E, U11F, U12E, U17T	14	7		U2G-A, U17T-B, D
74LS04	U2V, U3P, U4G, U4H, U8A, U8B, U8C, U16T	14	7		U2V-B, F, U8R-D, U4H-B, C, D, E, U16T-D, E
74LS08	U1P, U4P, U7H, U7V, U14R, U16W	14	7		U1P-C, D, U7H-C, U14R-A, B
74LS10	U16R	14	7		U16R-B, C
74LS11	U3G, U4V	14	7		U3G-C, U4V-B
74LS14	U3P, U14A, U14D, U14G, U5R	14	7		
74LS32	U1H, U2P, U5K, U6R, U9M, U12M, U13M	14	7		U13M-B
74LS42	U1K	16	8		
74LS74	U5P, U13R, U13W, U14P, U14T, U17R	14	7		
74LS86	U4W, U12B, U12C, U12D, U12F, U12G, U16M, U16N, U17M	14	7		U4W-B, U12F-B, C, U17M-A
74LS109	U3D, U5H, U6A, U6B, U7A, U7B, U13B, U13C, U13E, U13F, U13M	16	8		U5H-A
74LS125	U13P	14	7		
74LS132	U7P	14	7		U7P-B, C
74LS138	U6W, U8D	16	8		
74LS151	U7C, U10F, U10G	16	8		
74LS153	U7E	16	8		
74LS157	U9E	16	8		
74LS163	U4D, U7D, U9A, U9B, U9C, U9D, U10B, U10C, U10D, U10E, U11D, U17W, U18W	16	8		
74LS164	U7F, U8E, U8F, U9F, U14W	14	7		
74LS174	U6F, U6G, U6V, U13A, U13D, U13G, U13V, U15V, U16K, U16P, U16V	16	8		
74LS175	U10M, U12V, U14V, U17L, U17N	16	8		
74LS195	U3K	14	7		
74LS240	U11W	20	10		
74LS244	U5T	20	10		
74LS245	U7R, U7T	20	10		
74LS280	U11V	14	7		
74LS367	U3R, U4R	16	8		
74LS368	U16L	16	8		
74LS373	U1L, U2L, U6T	20	10		
74LS374	U2W, U15W	20	10		
74S10	U5F	14	7		U5F-B
74S140	U2E	14	7		U2E-B
82S129	U7G	16	8		
339	U6H, U19T	3	12		
2128	U3N, U5N	24	12		
2764	U3L, U5L	28	14		
4864	U9P, U9R, U9T, U10P, U10R, U10T, U11P, U11R, U11T *CORRECT PINOUT	8	16		
6305	U12H	16	8		
6336-1	U9G, U17V	24	12		

IC TYPE	REFERENCE DESIGNATOR	+5R	+5V	GND	UNUSED
7404	U2K	14	7		
7406	U16J, U17X, U18X	14	7		U17X-B, C, D
7407	U6P, U10H, U17J, U17K	14	7		U10H-C, D, U17J-B, C, F
7414	U17P	14	7		U17P-D, E, F
7438	U7W, U8W, U9W, U14M	14	7		
74121	U13T	14	7		
8237A-4	U2T	31	20		
ADC1001	U6N	20	10		
DAC1006	U6M	20	10		
MC4024	U3C	14	7		
MC4044	U5G	14	7		
Z8002	U2N	10	31		
Z8036	U9L, U11L, U13L	23	7		
RES PACK	U3W, U10W	16	8		
RES PACK	U4T	1-8			

B. -6V +5V DEVICES

IC TYPE	REFERENCE DESIGNATOR	-6V	+5V	GND	UNUSED
4051	U7J, U7N	7	16	8	
4053	U2B	7	16	8	

C. -12V +15V DEVICES

IC TYPE	REFERENCE DESIGNATOR	-12V	+15V	GND	UNUSED
319	U14C, U4F, U14H, U15A, U15C, U15D, U15F, U15G, U15H	6	11		
709P	U19A, U19B, U19C, U19D, U19E, U19F, U19G, U19H, U19I	4	7		
4136	U2A, U2C, U20N	7	11		
71082	U6J, U6K, U6L, U18A, U18B, U18C, U18D, U18E, U18F, U18G, U18H, U18I, U18M	4	8		

D. MISC DEVICES

IC TYPE	REFERENCE DESIGNATOR	UN	REG	GND	UNUSED
393	U3H	8	20V	4	

4. LAST USED REFERENCE DESIGNATOR

C	221	R	321	W	3
CR	13	S		E	2
DS		TP	86		
J	1	U			
K	1	VR	2		
P	7	Y	1		
Q	26	L	1		

REVISION				
LTR	DESCRIPTION	DWN	DATE	APVD
A	ENL RELEASE	GB	10/82	DN
B	INCORP ECO 15029	EC	1/83	21
C	INCORP ECO 15480	EC	5/83	11/83
D	INCORP ECO 15448	EC	5/83	11/83
E	INCORP ECO 15733	EC	5/83	11/83
F	INCORP ECO 15574	EC	5/83	11/83
G	INCORP ECO 15785	EC	5/83	11/83
H	INCORP ECO 15658	EC	5/83	11/83
J	INCORP ECO 16267	EC	5/83	11/83
K	INCORP ECO 16728	EC	5/83	11/83
L	INCORP ECO 16746	EC	5/83	11/83

360105-322

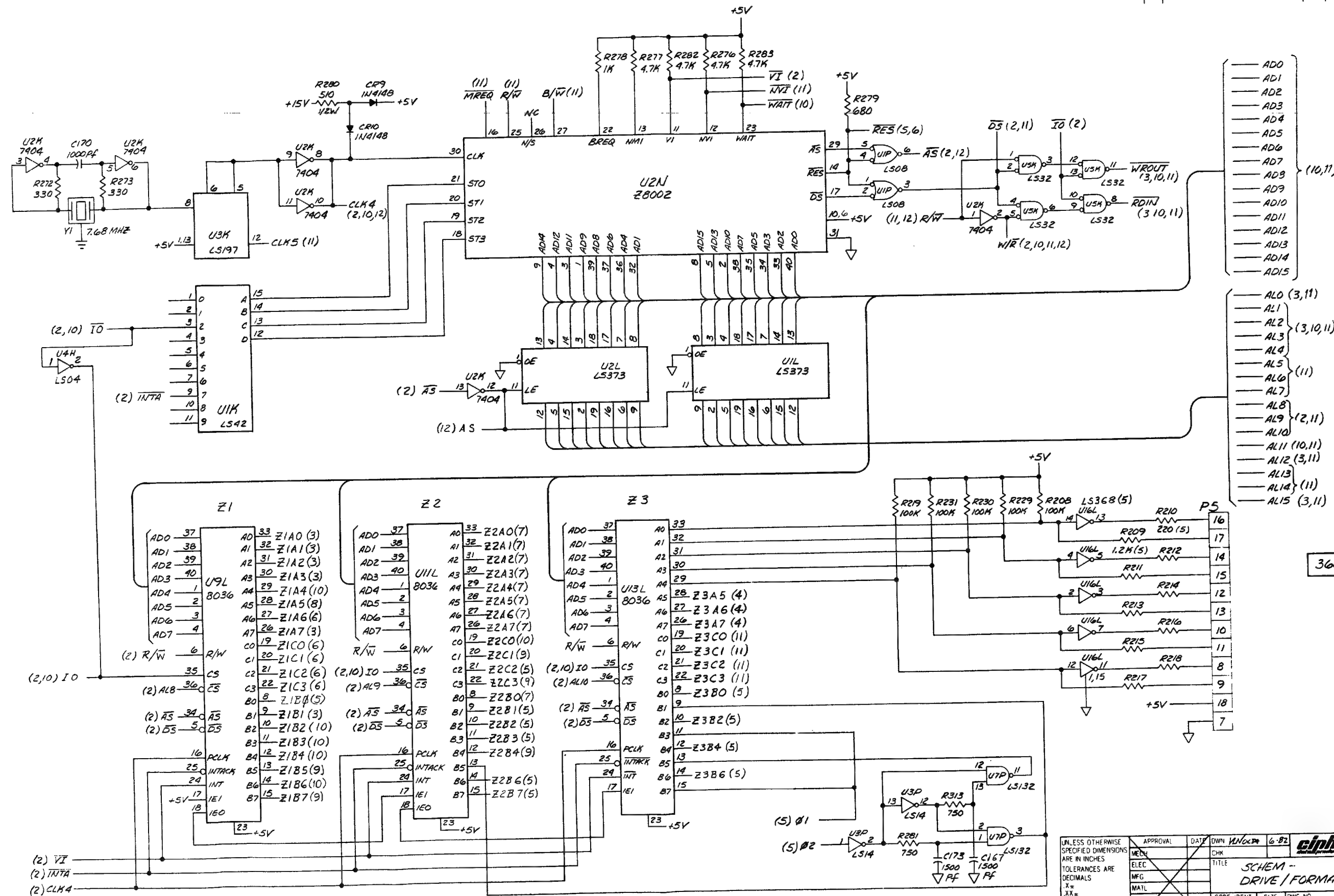
REV	STATUS	REV	STATUS	REV	STATUS	REV	STATUS	REV	STATUS	REV	STATUS	REV	STATUS	REV	STATUS
SH	1	2	3	4	5	6	7	8	9	10	11	12			

DESIGNER	DATE	12/1/82	16 88	elphel	SAN DIEGO CALIF
REVIEWER	DATE	12/1/82	11/88		
APPROVAL	DATE	12/1/82	11/88		
ELECT	DATE	12/1/82	11/88		
MATL	DATE	12/1/82	11/88		
QA	DATE	12/1/82	11/88		
ISSUED	DATE	12/1/82	11/88		
SCALE	MOD	SH	7	OF	72
CODE	DENT	SIZE	DWG NO	REV	
32274	D	360105-322			


ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE. IT IS THE POLICY OF THE NATIONAL ARCHIVES TO MAKE AVAILABLE TO THE PUBLIC ALL INFORMATION CONTAINED HEREIN THAT IS NOT LAWFULLY RESTRICTED FROM PUBLIC RELEASE.

THIS DOCUMENT IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE. IT IS THE POLICY OF THE NATIONAL ARCHIVES TO MAKE AVAILABLE TO THE PUBLIC ALL INFORMATION CONTAINED HEREIN THAT IS NOT LAWFULLY RESTRICTED FROM PUBLIC RELEASE.

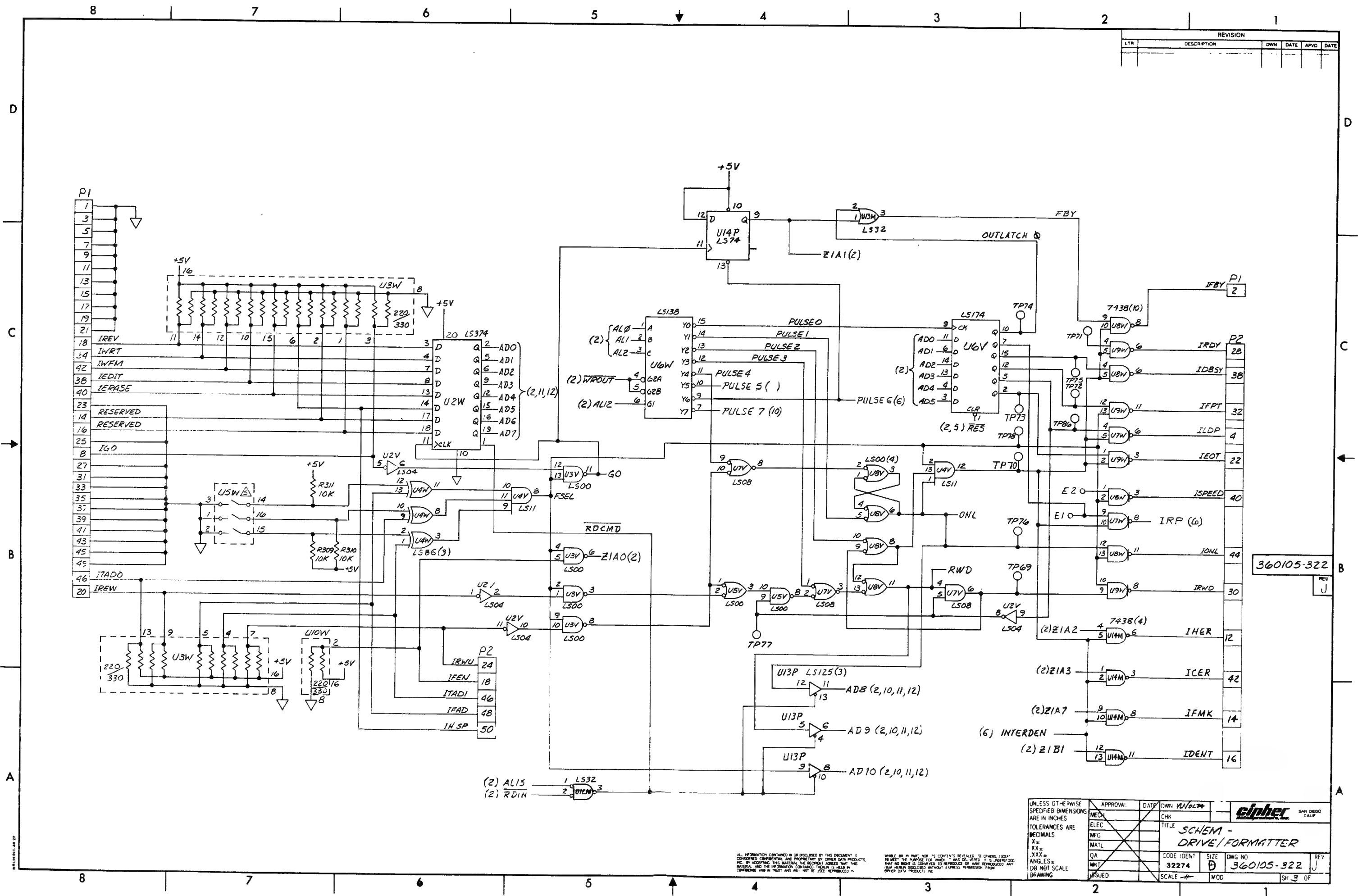
REVISION				
LTR	DESCRIPTION	OWN	DATE	APVD



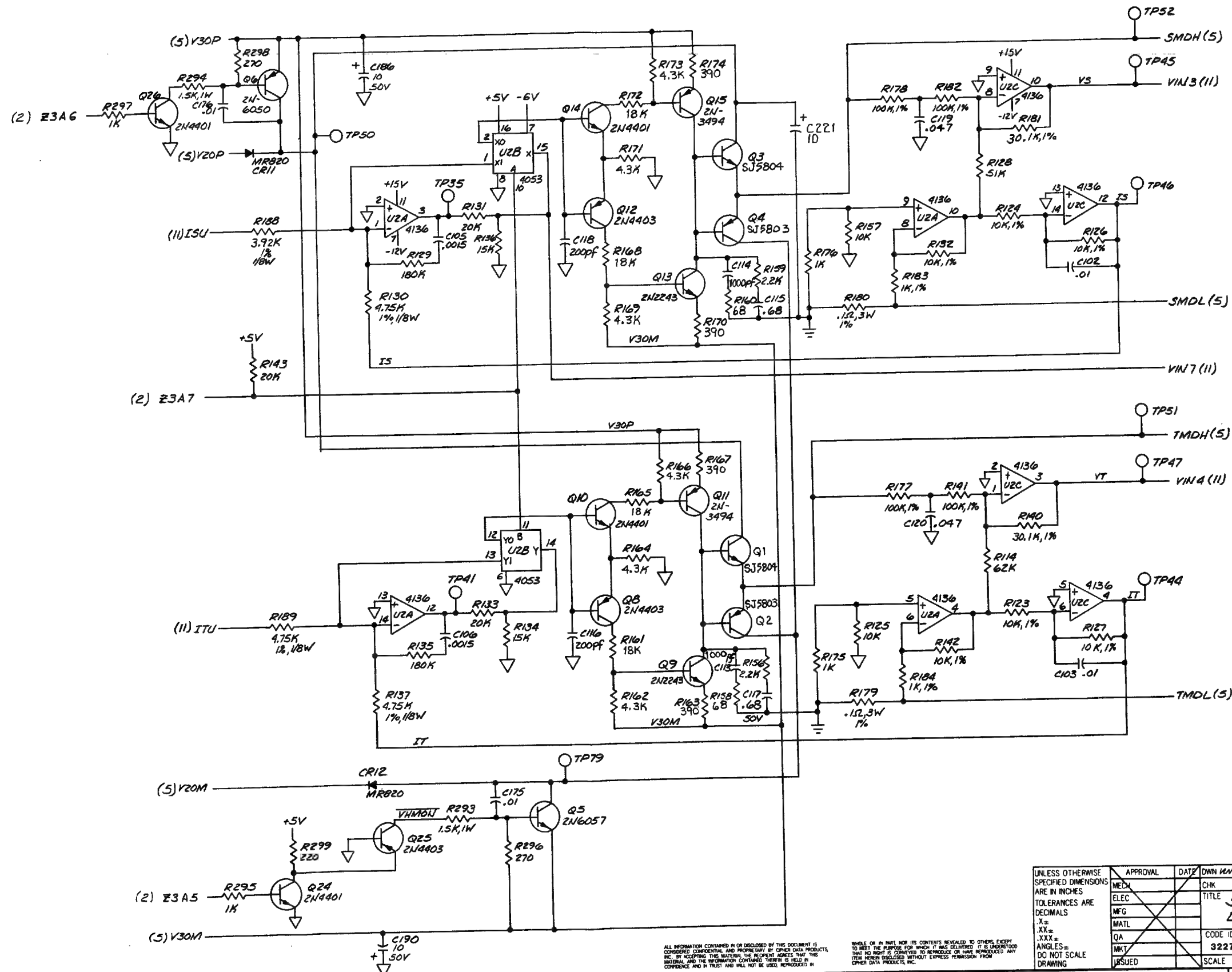
360105-322
REV F

UNLESS OTHERWISE SPEC'D DIMENSIONS ARE IN INCHES TOLERANCES ARE DECIMALS .XX= .XXX= ANGLES= DO NOT SCALE DRAWING	APPROVAL	DATE	DWN	6-82	 CIPHER Aerial Products, Inc.	SAN DIEGO CALIF	
	MECH		CHK				
	ELEC		TITLE				
	MFG		SCHEM -- DRIVE / FORMATTER				
	MATL		CODE IDENT				
	QA		SIZE	DWG NO	REV		
	MNT		32274	D	360105-322		1
	ISSUED		SCALE	MOD	SH 2 OF		

ALL INFORMATION CONTAINED IN OR DISCLOSED BY THIS DOCUMENT IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE. IT IS THE POLICY OF THE NATIONAL ARCHIVES AND RECORDS SERVICE TO MAKE AVAILABLE TO THE PUBLIC INFORMATION CONTAINED HEREIN. THIS INFORMATION IS BEING RELEASED WITHOUT LIMITATION OF ANY OTHER FEDERAL LAWS, REGULATIONS, OR EXECUTIVE ORDERS. CONFIDENTIALITY AND PROPRIETARY RIGHTS ARE NOT BEING ASSERTED.



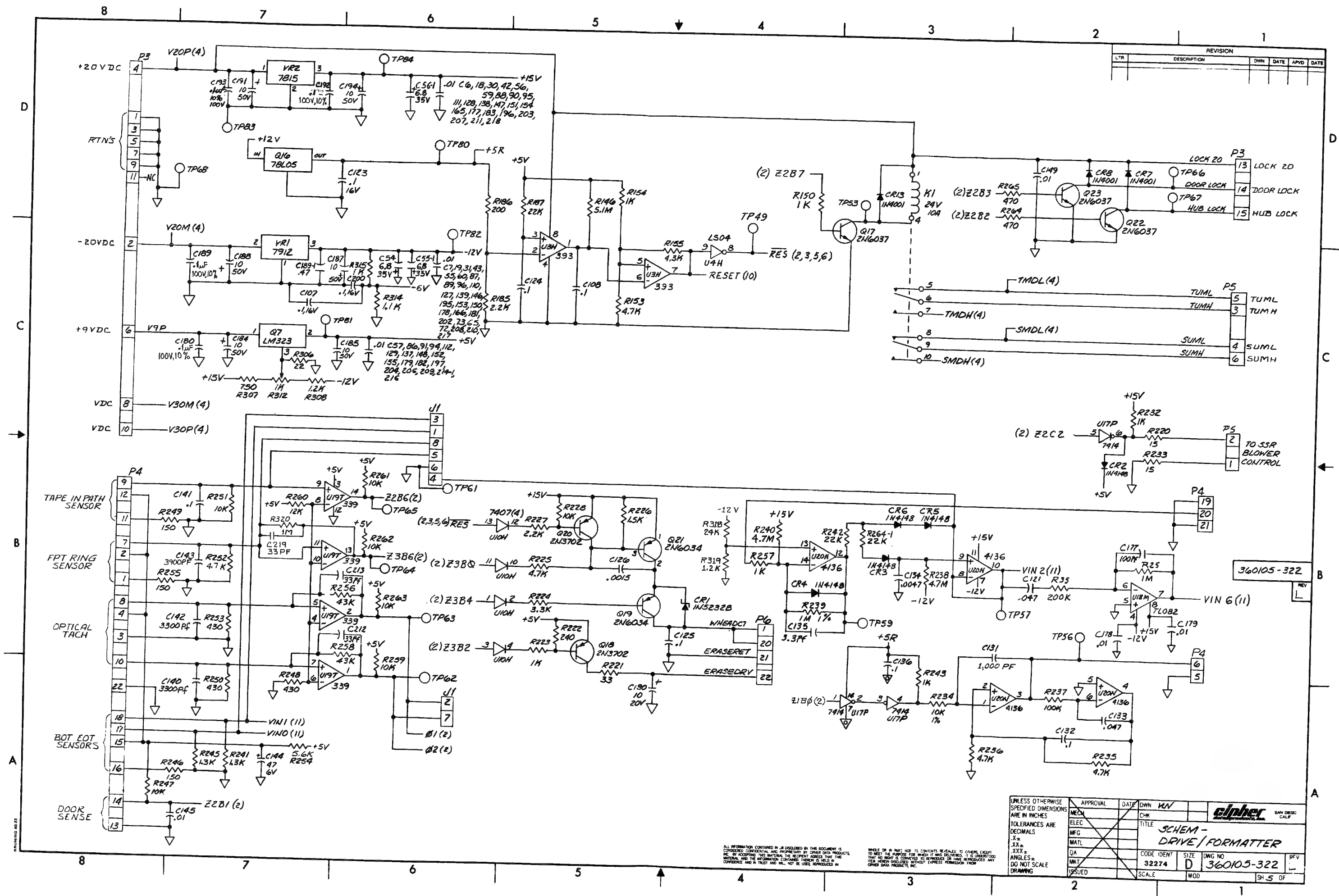
REVISION				
LTR	DESCRIPTION	OWN	DATE	APVD

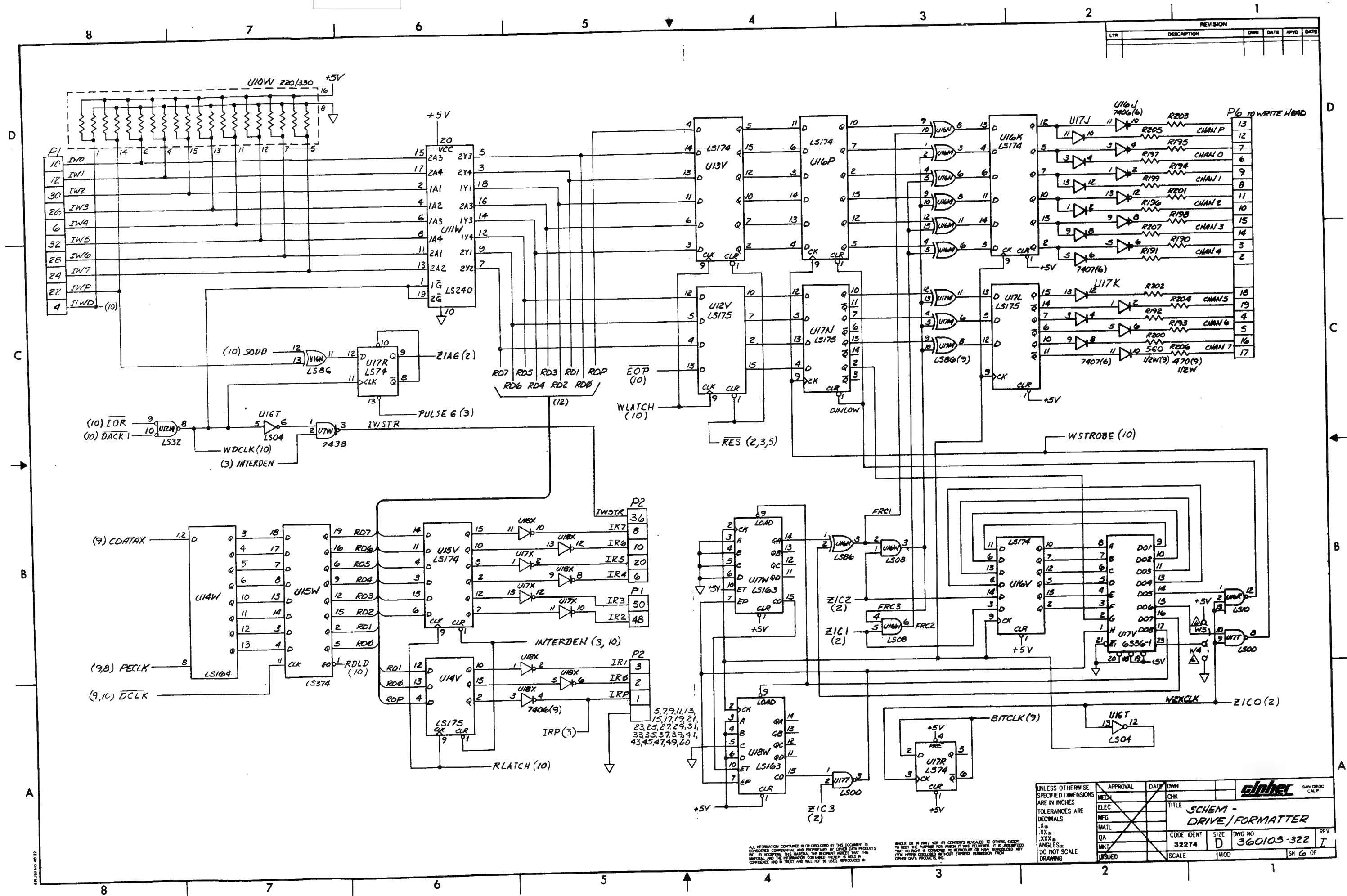


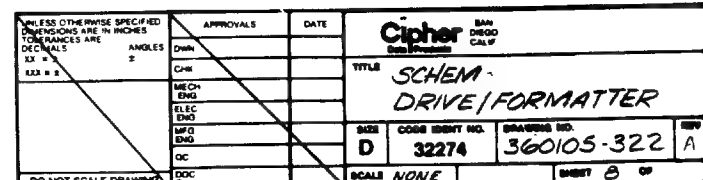
360105-322

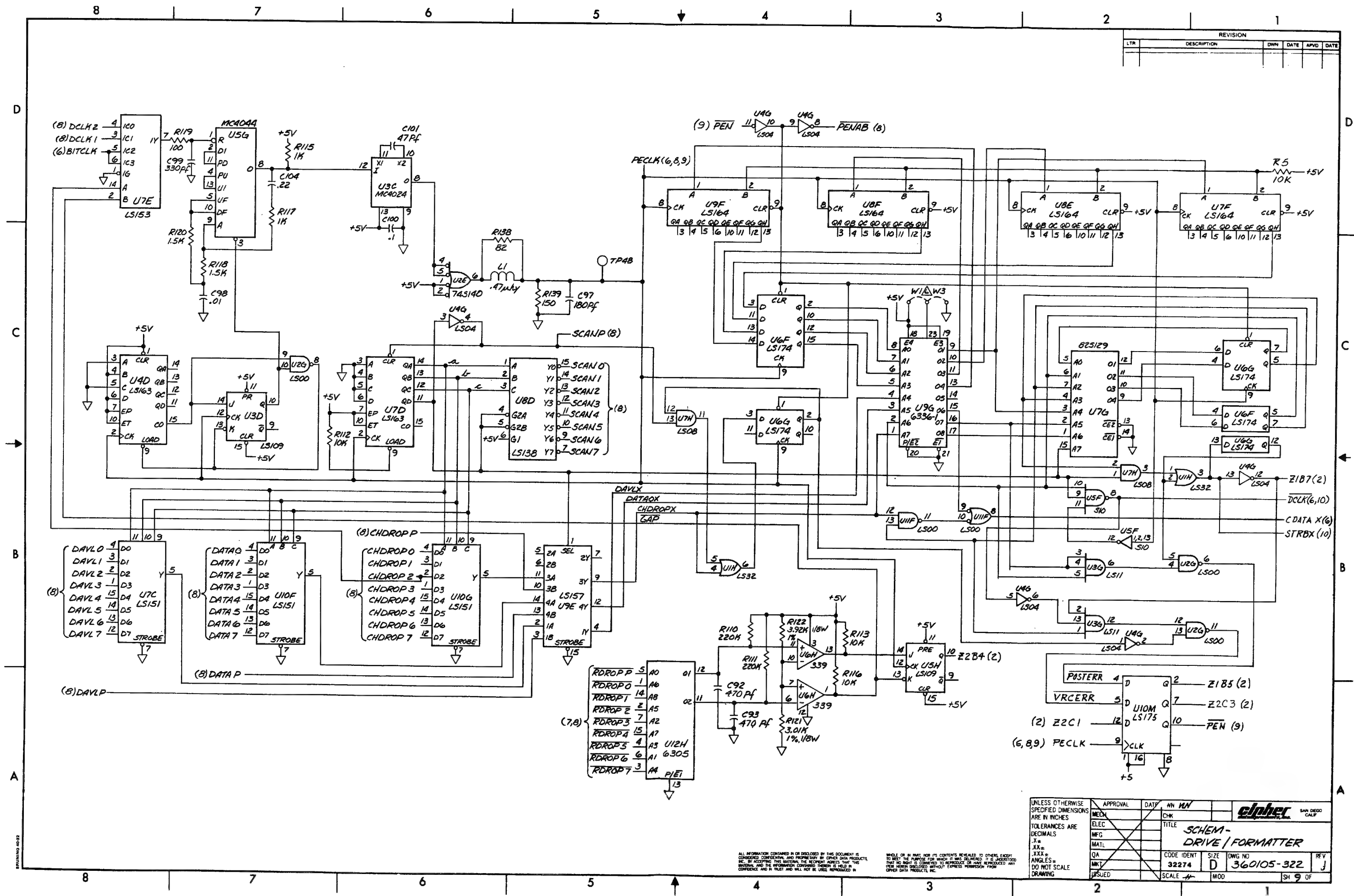
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		APPROVAL	DATE	OWN	CHK	elphed SAN DIEGO CALIF	
MFG	ELEC	TITLE		CODE IDENT	SIZE	DWG NO	REV
MATL	QA	SCHEM-DRIVE/FORMATTER		32274	D	360105-322	J
ISSUED	SCALE	MOD		SH 4 OF			

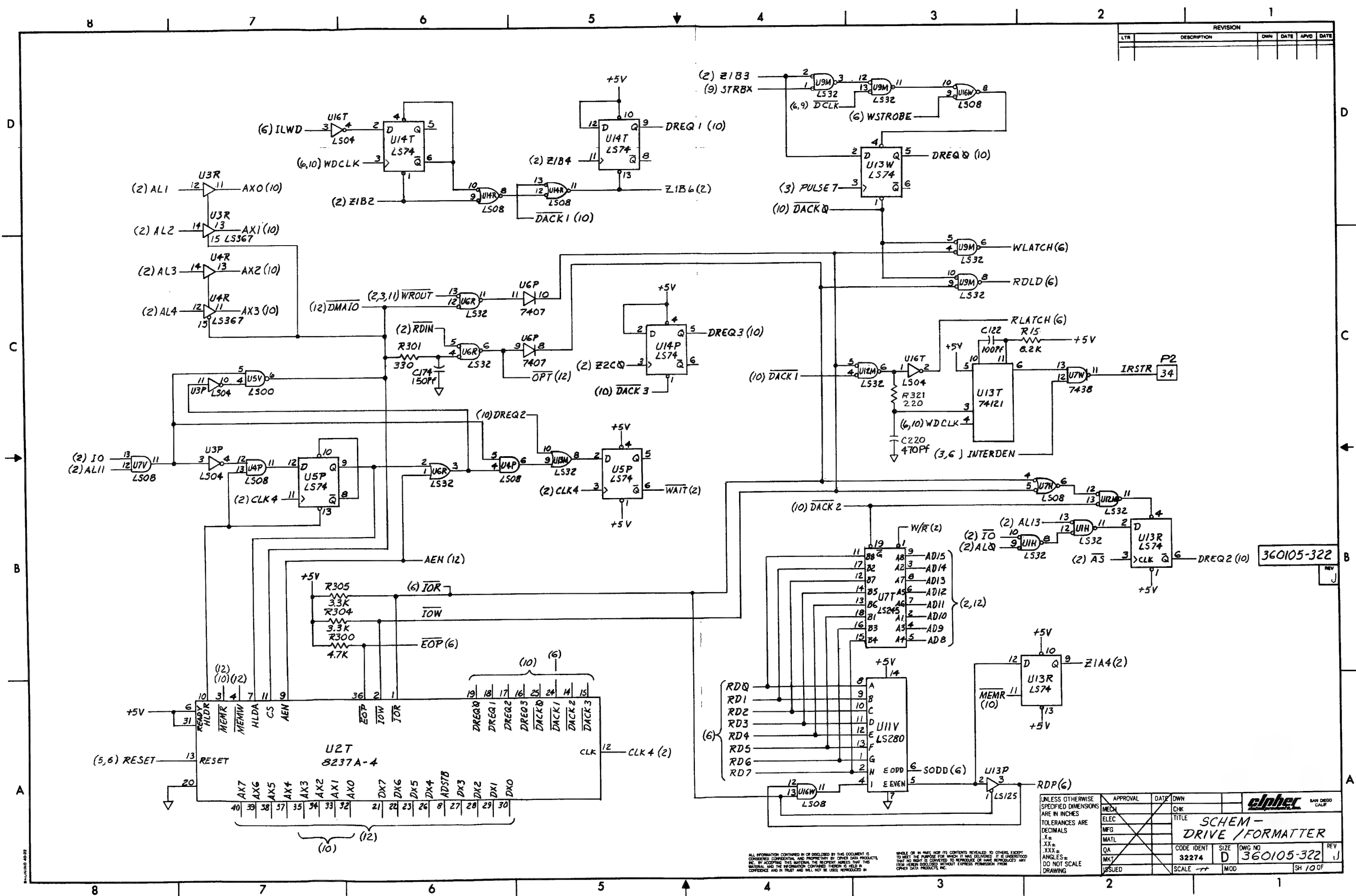
ALL INFORMATION CONTAINED IN OR DERIVED BY THIS DOCUMENT IS CONSIDERED CONFIDENTIAL AND PROPRIETARY BY OTHER DATA PRODUCTS, INC. BY ACCEPTING THIS MATERIAL THE RECIPIENT AGREES THAT THIS MATERIAL AND THE INFORMATION CONTAINED THEREIN IS HELD IN CONFIDENCE AND IN TRUST AND WILL NOT BE USED, REPRODUCED IN WHOLE OR IN PART, NOR ITS CONTENTS REVEALED TO OTHERS, EXCEPT TO MEET THE PURPOSE FOR WHICH IT WAS DELIVERED. IT IS UNDERSTOOD THAT NO RIGHT IS CONVEYED TO REPRODUCE OR HAVE REPRODUCED ANY ITEM HEREIN DISCLOSED WITHOUT EXPRESS PERMISSION FROM OTHER DATA PRODUCTS, INC.

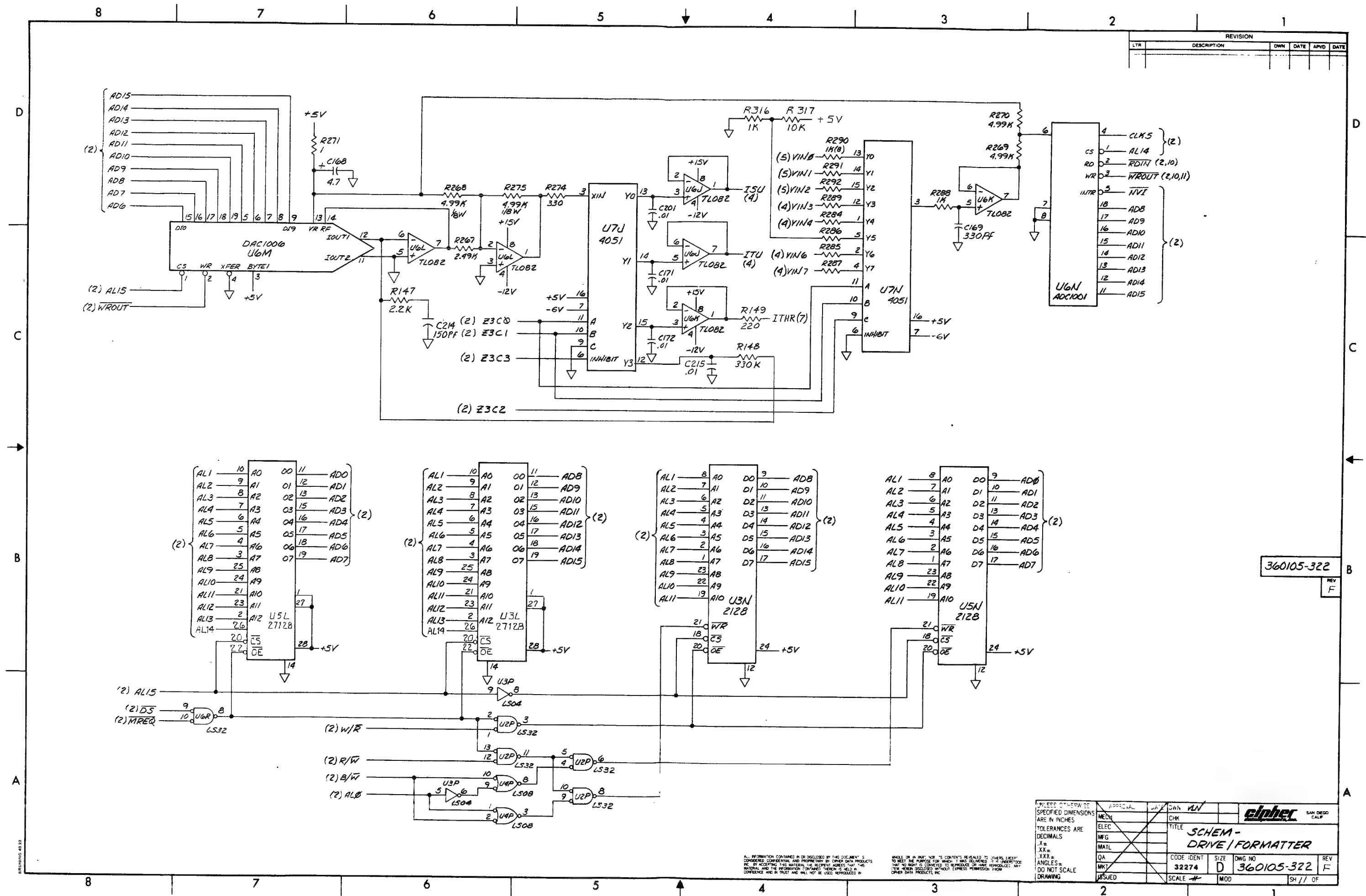


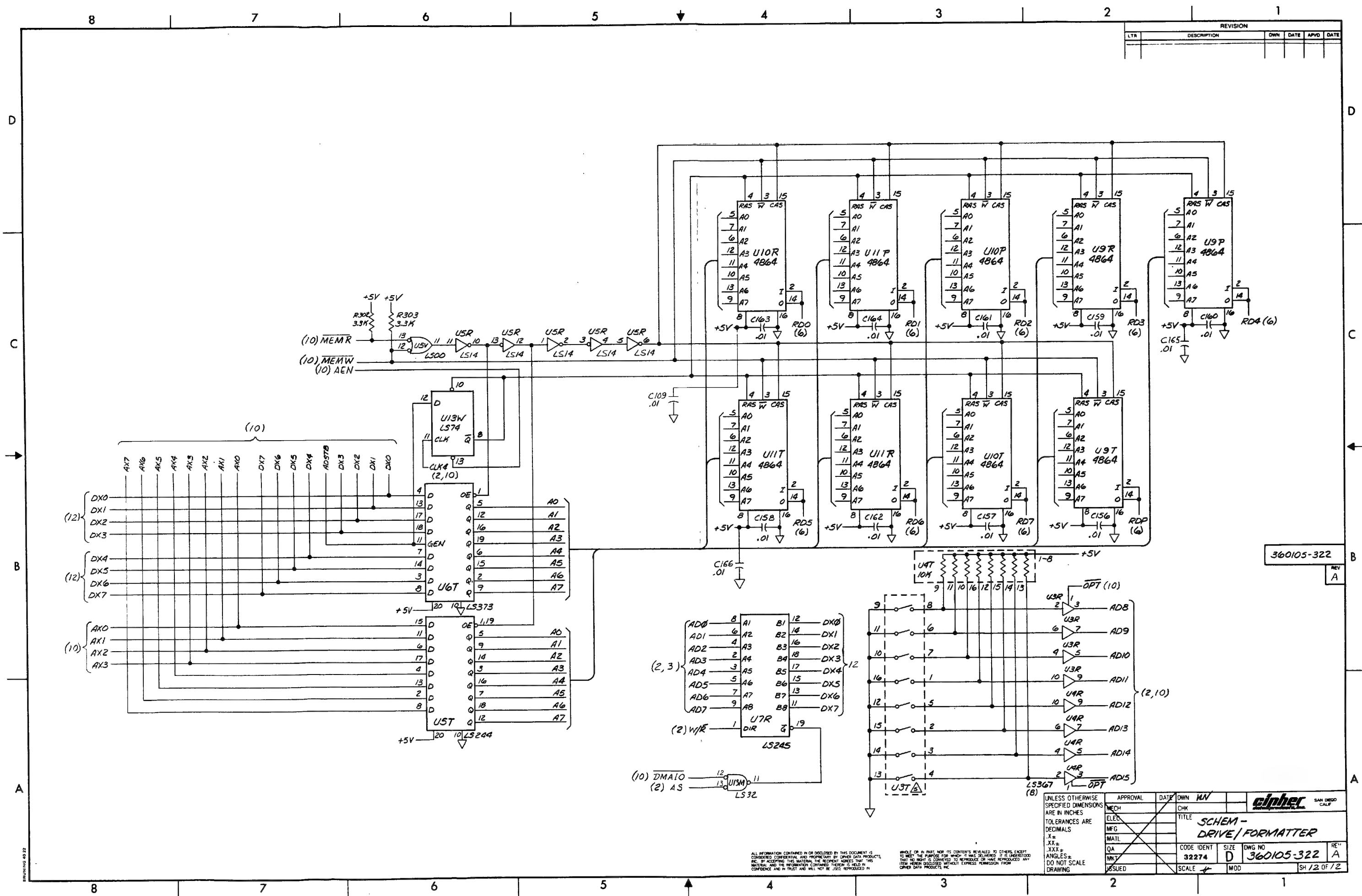








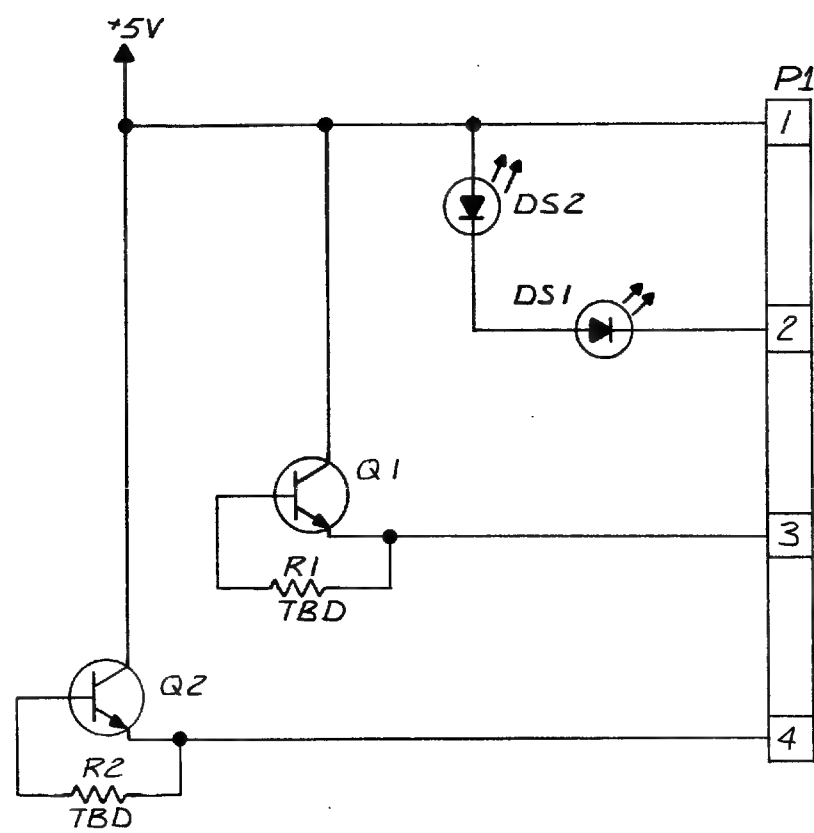




360102-319

REV B

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENGR. RELEASE	SS	7/13/81	MT	7/19/81
B	INCORP ECO 13040	LIA	7/20/81		5-88



"All information contained in or disclosed by this document is considered CONFIDENTIAL and PROPRIETARY by Cipher Data Products, Inc. By accepting this material the recipient agrees that this material and the information contained therein is held in confidence and in trust and will not be used, reproduced in whole or in part, nor its contents revealed to others, except to meet the purpose for which it was delivered. It is understood that no right is conveyed to reproduce or have reproduced any item herein disclosed without express permission from Cipher Data Products, Inc."

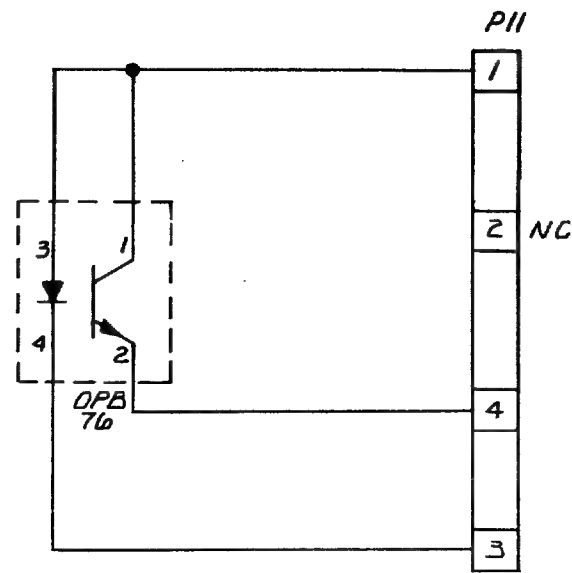
NOTES:
1. 160101-010 CONTAINS DS1 ONLY.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS .XX = ± XXX = ±		APPROVALS DWN SCHNEIDER CHK [Signature] MECH [Signature] ELEC [Signature] ENG [Signature] QC [Signature] DO NOT SCALE DRAWING		DATE 5-13-81 5-17-81 3-18-81 7-18-81 7/19/81 7/19/81	 Cipher SAN DIEGO CALIF TITLE SCHEM-REFLECTIVE SENSOR		SIZE B	CODE IDENT NO. 32274	DRAWING NO. 360102-319	REV B
SCALE					SHEET 1 OF 1					

360101-309

REV B

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENGR-RELEASE	RA	1/31/80	MT	7/20/80
B	INCDRPECD 9223	RL	5/20/80	SL	5-13-80



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: .XX = ± .005 .XXX = ± .010		APPROVALS		DATE	Cipher SAN DIEGO CALIF Data Products			
		DWN <i>R. Abad</i>		1-30-80				
		CHK <i>R. Dobbs</i>		2-19-80	TITLE SCHEM - FILE PROT. SENSOR			
		MECH ENG <i>[Signature]</i>		2-20-80				
ELEC ENG <i>[Signature]</i>		2-20-80						
		MFG ENG <i>[Signature]</i>		2-11-80	SIZE	CODE IDENT NO.	DRAWING NO.	REV
		QC <i>[Signature]</i>		2-11-80	B	32274	360101-309	B
		DOC CHK <i>[Signature]</i>		2-20-80	SCALE	NONE	SHEET	1 OF 1
DO NOT SCALE DRAWING								

Technical Manual Nos.
799816-004
and
799816-006
Revision C

M890 AND M891 CACHETAPE UNIT
ERRATA SHEET
NUMBER I

NOTE

This Errata Sheet contains information about changes made to the product subsequent to the printing of the technical manual. This information needs to be incorporated into the manual by the user to ensure that the manual accurately describes the product.

Correct the following five paragraphs:

1. 1-1 Add at the end of the paragraph: Autoload capabilities for the CTU will accommodate 7, 8 1/2 and 10 1/2-inch reel sizes.
2. 1-15 The initial sentence should read: The newly expanded final incrementation of maximum block size will remain fixed for the entire remainder of tape, and will reset to the selected block size only upon receiving an unload command.
3. 1-18 Change the following:
 - a. The title and the first sentence to read: Special Software Option No. 2 (Post-EOT and DOUBLE FILEMARK Streaming). This switch selectable option enhances the performance of restricted software and will allow the CTU to operate optimally with systems designed for older conventional start/stop drives.
 - b. Add the following to line 7: ...the tape. The standard CacheTape performs a Write Sync (dumps cache data to tape) at EOT and when a Double Filemark command is issued for purposes of informing the host of the exact physical position of tape by the status for these two critical operations. Some older tape handling conventions experience timing problems when Write Sync is invoked. This auto-Write Sync on Double Filemarks or EOT may cause time-outs or affect throughput performance when the conventions mentioned above apply. The option may ...
4. 1-19 Change the following:
 - a. The first sentence should read: Some software and couplers require the presence of IDENT status when operating...
 - b. The third sentence should read: When operating from load point, this option will cause the IDENT interface status line to be asserted...
 - c. The last sentence should read: IDENT status will be asserted for 1600 BPI operation at all times (per ANSI standard).
5. 1-29 Add before paragraph 1-30: NOTE: IHER is latched for any Write command operation that cannot be completed due to a catastrophic error. Detailed error information can be accessed through an extended read command issued by the host at this time.

Correct the following six tables:

1. 1-1 Line 5 should read: 230- (204-253)
Frequency (Hz) block for all cases should read 49-61.
2. 1-2 Change block 2 as follows: "Position" was 4-6, is 6-8.
Change block 3 as follows: "Position" was 7/7, is 4/4.
Change block 4 as follows: "Position" was 8/8, is 5/5.
3. 1-7 On page 1-26, the Access Code (top right) should be 10000.
4. 2-2 Change Error Code 28 to read: Tape reel prevented movement of the supply reel hub. Remove and re-insert

tape reel to clear, or bellcrank solenoid failure.

5. 3-3 Delete Pust Test No. 12, BOT/EOT sensors.
6. 3-6 Add the following to "Conditions" column of Error Code 24: Generally, host cannot sustain throughput at present speed setting.